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DISTRIBUTION AND FREQUENCY OF DIRECTION OF GROUND AIR CURRENTS --ETC(U)
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DISTRIBUTION AND FREQUENCY OF DIRECTION OF GROUND AIR CURRENTS IN THE POLISH TATRA MOUNTAINS

by

Janina Lewinska

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DISTRIBUTION AND FREQUENCY OF DIRECTION OF GROUND AIR CURRENT IN THE POLISH TATRA MOUNTAINS

Janina Lewinska

The basic physiographic factors of an environment are meteorological phenomena. Until recently they have not been considered in economic planning. An obvious and sad example is shown by crowded, smoky towns, poisoned by exhaust from poorly located industrial plants, devoid of greenery, etc., and, most of all, built often in the wrong places (particularly health resorts) not serving their purpose. In some cases it would appear that it is already too late for a change. However, each human culture lives, develops, grows, or fades away. In the era of Socialism, these changes do not occur by accident, but are directed by rational economic planning. This planning should be based on combining physiographic studies with space considerations, utilizing progress in modern science. The economic activity of man should be based on laws of nature, in order to ensure the most appropriate utilization of these laws of nature for the interest of society.

This publication is concerned with only one meteorological factor - wind - a factor which is very important in the careful planning of a town, particularly resorts.

Tatras and Podhale contain many convalescent-sanatoriums and rest homes or resort facilities. The role of wind is enormous. A very important problem in places of this type is protecting the terrain from cold masses of air, especially from the North, by the appropriate location of buildings or well-planned green areas (parks, windbreak belts).

Mountainous areas create specific conditions for the flow of air masses. Air currents behave to a certain degree in a manner similar to that of water in a drain. Different results are produced, depending on the valley shape, its depth, narrowings and broadenings. Thus a pass in a mountainous valley will cause convergence, and thus an increase of the wind velocity for a given sector. Conversely, we have the phenomenon of divergence - spreading of air streams as a result of broadening of orographic forms and the resultant reduction in the wind velocity.

Moreoever, there are other disturbances of the air flow over mountainous regions, such as turbulence or convection caused by local disturbance of thermal equilibrium.

All of these above factors cause the winds in mountain areas to be modified by local characteristics of the ground, and their distribution depends greatly on these features.

MATERIALS AND PROCEDURE

Processing the available anemometric material encounters serious difficulties, arising from the low precision of measuring instruments used for observations, as well as varied observational conditions. As far as the measuring instrument is concerned, except for the Kasprowy Wierch station, a Wild type anemometer was used, which is not very accurate. Thus we concentrated on only one wind element - its direction, which is easy to observe even in observations without instruments. In addition to various methods of observation and nonconcurrence of the periods treated, a no less important shortcoming which was difficult to avoid was nonuniform height of the anemometers, their different surroundings, and changes in the station locations. Unfortunately, we had no appropriate correction factors which enabled us to eliminate differences arising for the

above reasons.

Considering in turn the problem of wind velocity, it appears that wind velocities recorded on the basis of Wild anemometers may be treated as approximate values only and not the basic ones, particularly since when collecting observational data it was not noted whether the stations were equipped with anemometers with heavy plates. The Wild type anemometers fitted with normal plates weighing 200 g measure wind velocities only up to 20 m/sec, whereas previous anemometric observations established considerably higher wind velocities in Tatras.

Nevertheless, we calculated wind velocities for Hala Gasienicowa, in order to obtain in this way the data characterizing the transition area between Zakopane with calculations according to Guminski and Kasprowy Wierch with calculations according to Orlicz.

The observational material is presented below:

Number	Name of station	Period of observation	Number of years
1	Antołówka	1952—53	2
2	Bukowina	1949—53	5
3	Dolina Chochołowska	1951—53	3
4	Dolina Pięciu Stawów	1950—53	4
5	Głodówka	1951—53	3
6	Gubałówka—Pająkówka	1927—36	10
7	Hala Gasienicowa	1927—38,47—53	19
8	Hala Ornak	1950—53	4
9	Kasprowy Wierch	1938—51	14
10	Kuźnice	1950—53	4
11	Łysa Polana	1951—53	3
12	Morskie Oko	1927—38,48—53	18
13	Myślenickie Turnie	1949—53	5
14	Poronin	1927—38,47—53	20
15	Witów	1951—53	3
16	Zakopane	1921—39,43—44	21

Polish reports are available to the public per Mrs. Luttrell, AFFTD/NIIS.

It is seen from the above compilation that the shortest series comprises two years, or 2004 observations, whereas the longest one takes 21 years, or 21,732 observations.

This work considered all the stations located in the discussed area. For 14 stations among them we calculated the frequency of wind directions in %% for months, seasons of the year, and year. Moreover, for Hala Gasienicowa we calculated frequencies of velocities in ranges adopted by Bartnicki. Statistical materials for Kasprowy Wierch were taken from the work of Orlicz [19], and for Zakopane from the work of Guminski. Then we drew compass point diagrams for winds on hipsometric bases of the map of Tatras to the scale 1 : 50,000. In addition we developed diagrams of the frequency of wind directions for 16 stations by the isoplet method, and drew compass point diagrams by the method of Okolowicz [18] taking into account both elements of wind, that is direction and velocity, which are often treated separately. In this way we obtained material for the frequency of directions of 16 stations, and for velocity from 3 stations located at different levels of altitude.

The work with such diverse observational material appears desirable because of economic needs, especially since the presently available data relative to anemometric conditions of Polish Tatras and Podhale are based on only few stations, and the most important studies in Polish literature on this subject are the work of Kosinska-Bartnicka [7] based on one-year observations and the work of Orlicz [19] discussing anemometric conditions in the top (peak) part of Tatras.

The descriptive part of this work is supplemented by:

1) tables of the frequency of wind directions in %% for months, seasons of the year, year (Table 1),
2) tables of wind velocity in %% (Tables 2, 3 and 4),
3) maps of the points of compass for months, seasons of

year and year (including one quadrant map), altogether 18 maps (Figures 1-18),

4) graphical presentation of the frequency of wind velocities in %%, by the Okolowicz method (Figure 19).

Comparison of data for Zakopane from two different observation periods

The basic rule of statistical climatology is the law of preservation of the uniform observational series. Unfortunately, it was not possible because of too small a number of stations which had a longer series of observations. Hence, for the sake of comparison we took observational material from Zakopane for the period of two years 1952-53, i.e., the shortest period of observations utilized in this work (Antolowka).

When comparing data from Table 1 for Zakopane for the period 1921-39, 43-44 (referred to as Period I) with those for the period 1952-53 (referred to as Period II) one can see clearly an increase of days with silence (quiet days). In this connection, the frequency of particular wind directions becomes reduced.

Period II, similarly to Period I, has in the first place the winds from the SW sector. Whereas in Period I after the SW winds the second place was occupied by winds from the S direction, in Period II the second place is occupied by winds from the W sector, and then from NE sector. In general, one can state that in Period II the dominant winds were from the W quadrant. There may be two reasons for this behavior:

1) reduced number of föhn type winds,

2) changes in environment of the observational post.

Any proof for reason 1 or reason 2 is at present very difficult because of the lack of data of this sort. Nevertheless, if we consider that the highest wind velocities are noted from the S direction, then a reduced fraction of the winds of this type

could be the reason for an increased number of days of silence noted in the last period.

Geographic characteristics of the region

Although the basic topic of this work is the Polish Tatras, the region includes, in addition to this primary orographic section, Podhale adjacent on the North. Podhale is joined here with the area of the Tatras because of the climatic effect these geographic areas have on each other.

Podhale is a much lower area between Tatras and Beskid, and its landscape has few variations. A flat dale distinct in the Northern part changes towards the South into a hilly area ending with Podgorze Spisko-Gubalowskie. This is a broad ridge which has a height of 1000 m above sea level, running parallel in latitude. Its slopes are asymmetric: steep and short on the South side, long and gentle on the North side. For this reason, the highest areas are in the Southern part adjacent to Row Podtatrzanski. From this part of Podhale, observations were made at the following stations: Bukowina (880 m above sea level), Poronin (800 m a.s.l.), Gubalowka-Pajakowka (1123 m a.s.l.) and Witow (798 m a.s.l.).

Row Podtatrzanski is represented by two stations: Zakopane (835 m a.s.l.) and Antolowka (918 m a.s.l.). This Row arose at the boundary of Tatras and flish Podhale. Because of denudation processes, three large lower areas were formed: Koscieliskie (800 m a.s.l.) joined with Zakopanski (800 m) and Jaworzynskie (950 m) separated by Zgorzelisko and Cyrla ridges. The bottoms of these lower areas have denivelation to 80 m, as reported by Klimaszewski [6]. Meteorological station Glodowka (1149 m a.s.l.) is located in the foothills of the high Tatras, on the Cyrla ridge.

The rest of the stations are situated in the region of the Polish Tatras.

Because of different geological structures which condition orographic formation, Tatras in Polish teritory are divided into two parts: Western Tatras (Tatry Zachodnie) and High Tatras (Tatry Wysokie). They are separated by the Liliowe Pass, Dolina Stawow Gasienicowych and Dolina Suchej Wody.

Western Tatras are characterized by striking contrasts between gentle cupola-like ridges and deeply cut valleys and steep slopes. Western Tatras are represented by the following stations: Dolina Chocholowska (1028 m a.s.l.), Hala Ornak (1110 m a.s.l.), Kasprowy Wierch (1988 m a.s.l.), Kuznice (1023 m a.s.l.), Myslenickie Turnie (1367 m a.s.l.).

High Tatras differ from Western Tatras very clearly. They form the highest part of Tatras with sharp forms with very dense systems of valleys. The stations which lie in this region are Morskie Oko (1400 m a.s.l.), Dolina Pieciu Stawow Polskich (1668 m a.s.l.), and Lysa Polana (988 m a.s.l.). A meteorological station on Hala Gasienicowa (1520 m a.s.l.) lies at the junction of Western Tatras and High Tatras.

Description of location of meteorological stations

1. Antolowka Hs = 918 m. Meteorological station is located on Antolowka ridge, at the distance of about 400 m on ENE from culmination (940 m). The station forms a continuation of the profile of meteorological stations running across Tatras. It rises about 80 m above the bottom of Row Podtatrzanski and it represents meteorological conditions in upper parts of the Row.

2. Bukowina Hs = 880 m. Meteorological station is located on the N slope of Kramarski Wierch on the road from Bukowina to Bialki. Its location does not represent the average climatic conditions of Bukowina, because it is too large accessibile for the Northern flow of air.

3. Dolina Chocholowska Hs = 1028 m. Meteorological station is located at the break sections of the valley in SSW - NNE direction. below the junction of Sucha Woda valley and Starobocianska valley. The area is protected : from E by the mass of Ornak, Kominiarskie Wierchy, Stoly and Kopki; from S by the main core of Tatras; and from W by the mass of Rakon, Upalony and Bobrowiec. This station represents anemometric conditions of the described valley section.

4. Dolina Pieciu Stawow Polskich Hs = 1668 m. The valley is in the shape of a bowl, closed from N by the ridge of Swinica and Kozie Wierchy, from W and SW by the crest Walentkowa and Lipowskie Wierchy, and from SE by the crest Miedziany and Opalony. Meteorological station is located at the foot of Wyzna Kopa above Maly Staw. The axis of the bowl in SW - NE means that the highest frequency of winds is from W and E sectors. The station represents upper parts of Roztoki valley and lower parts of Dolina Pieciu Stawow.

5. Glodowka Hs = 1149 m. Meteorological station is located on the E slope of Cyrla, whose culmination is 1158 m. The slope falls steeply to Bialka valley with SSW - NNE axis. Measuring instruments are placed in a small forest clearing of radius 100 m. Chowancow Wierch (1037 m) forms a screen from the E direction. It is doubtful whether the station is representative of a larger area.

6. Hala Gasienicowa Hs = 1520 m. The station lies on the boundary between Western Tatras and High Tatras, in the upper part of Sucha Woda flowing from Zielony Staw Gasienicowy. This is a wide valley open from NE, and closed from NW by Uchrocie Kasprowe, from S by crest extended from Granaty to Kasprowy Wierch, and from E by Zolta Turnia.

7. Gubalowka-Pajakowka Hs = 1123 m. Meteorological station is located on SW slope of Gubalowka, falling steeply in the direction of Row Podtatrzanski. The difference of levels between

the station and the bottom of Row is about 300 m. The slope is unprotected from the West. From the North it is closed by Gubalowka ridge, and from the East, by hills perpendicular to the Tatras.

8. Hala Ornak Hs=1110 m. The station is in Dolina Koscieliska extending for 8 km from the Northern edge of Tatras to the main Tatra ridge at Blyszcz and Kamienista. The valley axis has a S-N direction. The valley is divided into three parts by narrowings with steep rocks. A meteorological station is located in the narrowest part of the valley, at the junction of a few side valleys. It is protected from the West by the massive Ornak, from the South by the main Tatra ridge, and from the East the Tatra massif is divided from Hala Ornak by the deepest Tatra pass - Tomanova which greatly influences wind directions noted at Hala Ornak.

9. Kasprowy Wierch Hs = 1988 m. Anemometer 2002 m. The Meteorological Observatory is on the main Tatra ridge in a depression extending across Tatras, near the geographical boundary between Western Tatras and High Tatras. In the South Kasprowy Wierch falls towards Cicha Woda valley, and in the North, towards Dolina Suchej Kasprowej. Kasprowy Wierch is surrounded by a wide valley and bowl, which, according to Orlicz, basically influence anemometric conditions on this peak.

10. Kuznice Hs = 1023 m. The station lies at Bystre brook, on its left side, on a 2-3 m terrace. The valley axis in which the station is located passes from the SSW to NNE. The narrow valley is surrounded by Boczania slopes in the SE, and by Krokiew in the NW. In the South the valley opens to the main crest of the Western Tatras.

11. Lysa Polana Hs = 988 m. The meteorological station is located in the high Tatras, on the left side of the Bialka river between the N edge of the Tatras and their foothills,

in a passage between SE slope and the high terrace of Bialka. The general direction of the valley is SSW - NNE.

12. Morskie Oko Hs = 1400 m. This is a bowl of glacial origin. Its axis runs from SW to NE. From SW direction the bowl is closed by Mieguszowieckie Szczyty and Cubryna, from E and NW - by ridges Zabie, Rysy, Miedziany and Opalony. The meteorological station is located on the frontal moraine, on the NE side of the lake, at the outlet of outflow valley of Rybi Potok.

13. Myslenickie Turnie Hs = 1367 m. Meteorolcgical station is located on the rocky ridge falling in the E direction towards Dolina Kasprowa, and in the W direction towards Dolina Goryczkowa. The ridge axis runs from NW to SE. In the S direction the terrain rises becoming the slope of Suchy Wierch. In general, the location of the station is on a slope.

14. Poronin - Kosne Hamry Hs = 800 m. Meteorological station is located in Poroniec valley. The axis of the valley runs from E to W. From the N the valley is bounded by Galicowa Grapa ridge (982 m), and in the S direction the Poroniec valley passes into a slope of Gubalowski ridge.

15. Witow Hs = 798 m. Meteorological station is located in a broad part of the Czarny Dunajec valley with gently sloping sides. The axis of valley runs from S to N. On the W side gentle hills up to 960 m do not form a real obstacle for winds from that direction.From the E the valley is protected by hills to 1000 m (Ostrysz 1025 m), and towards S the valley narrows to the site of junction of Siwa and Kirowa Woda.

16. Zakopane Hs = 835 m. At present, the meteorological station is located at Wilcznik, loosely built up. From the S Row Podtatrzanski passes into Northern parts of Tatras. From W and NW it is protected by Palenica and Gubalowskie ridge, and from E by hills extending from S to N. The axis of Zakopianka

valley has the direction SW - NE.

It is necessary to point out that the meteorological station was moved several times and, in this connection, the observational periods reported in this work come from two different points. In the period 1921 to 1939 and 1952 to April 1953 the station was located near Tatra Museum, and from May 1953 at Wilcznik.

Frequency of the directions of wind

Determination of the frequency of wind directions was made on the basis of three ending observations, that is at 07 h, 13 h, and 21 h at the average local time. All the observations were presented in percentile relation to the whole series of observations at a given station for months, seasons of the year and year. Next, the calculated values were plotted on 1:50,000 map by the method of 8-direction points of the compass, marking also at each point of compass the percent fraction of days with silence. The distribution of particular wind directions in monthly and yearly periods is as follows:

January (Figure 1). In January on the discussed area the prevailing winds are from S, SW and W. The lowest frequency is noted from the directions N through E to SE. An exception is provided by Kasprowy Wierch for which, after the S direction, the second strongly accented direction is N. This system,typical for Kasprowy Wierch,is caused, on the one hand, by a depression running across Tatras and, on the other hand, by a free access of air masses from the North. Characteristic systems of winds appear at Dolina Pieciu Stawow, Kosne Hamry (Poronin), and at Gubalowka. On the other hand, the system of winds for Hala Ornak, where the component E is strongly accentuated, finds no analogy at other Tatra stations. Nonetheless, it appears that the basic reason for this effect is the lowering of Tomanowa pass. In Row Podtatrzanski the prevailing winds in lower parts (Zakopane)

are winds from the SW sector, whereas in higher, more exposed parts (Antolowka) the prevailing wind is from the West. The amount of silence varies from 2.4 to 40% and above. We must note that meteorological stations located in higher passes, or in narrow mountain valleys, because of convergence have much
a smaller frequency
f~~ewer days~~ of silence than stations located at the bottom of broad valleys or in bowls.

February (Figure 2). A system similar to those discussed is noted also for February. However, a larger frequency of N and NE directions, as related to January, is now observed. The number of days with silence varies on the order of 40%, similarly to January.

March (Figure 3). In March we observe the predominance of S and SW directions. Kasprowy Wierch has more winds from the North sector than from the South sector. At Hala Ornak the system changes to the predominance of winds with a S-N component. At the remaining stations the system of winds is similar to that of previous months.

April (Figure 4). The general situation with atmospheric pressure and prevailing winds connected with it for the entire Polish Lowlands has no effect on anemometric conditions in Tatras.

The prevailing winds are from the S and SW sector. In Row Podtatrzanski, after winds from the SW sector, second place is held by the NE direction.

May (Figure 5). The map showing directions of ground air currents for this month reflects somewhat the effect of the general baric situation. The pressure drop over the Hungarian Valley and the Balkans, and an increase of pressure in the North result in a larger volume of winds from the N, NW, and NE sectors, which is shown on the attached maps and tables.

June (Figure 6). June shows also prevalence of winds from the N and NE directions. Thus, Kasprowy Wierch and Hala Gasienicowa note the prevailing winds from N direction, whereas Myslenickie Turnie from NE direction. On the other hand, Antolowka (Row Podtatrzanski) shows crossing of NW and NE currents.

July (Figure 7). In comparison with previous months, we see that the component N continues to prevail but only for Kasprowy Wierch and Hala Gasienicowa. On the other hand, Kuznice which lie in the profile of Kasprowy Wierch show prevalence of winds from the S sector. This diametrically opposite system may be explained by free inflow to Kasprowy Wierch of ground air currents from N direction, and by the protective action of Spisko-Gubalowski hills and of High Beskid in relation to stations located in lower parts. In addition to these reasons, a large role in the system of wind directions is played by local circulation of air between peaks and valleys, caused by temperature gradients. Determination of the magnitude of effect of local air circulation, because of differences in heating of peaks and valleys, would be possible by the analysis of daily anemometric observations, but it would already exceed the scope of the present work.

August (Figure 8). This month shows only small changes in the distribution of wind directions in relation to July. A lesser role of winds from the N sector is seen at Kasprowy Wierch. Meteorological stations located in Row Podtatrzanski show the prevalence of winds from SW sector.

September (Figure 9). The winds from S and SW directions continue to prevail in the whole area. In comparison with the previous month, the component N shows smaller values (Kasprowy Wierch and Hala Gasienicowa).

October (Figure 10). A general baric situation causes the formation over Poland of a ridge of high pressure, and an increase

of pressure towards the E (continental elevation). As a result we have a reduced participation of winds from W direction, which is particularly noted at the stations Witow, Antolowka and Dolina Pieciu Stawow. At the remaining stations the system is similar to that in previous months.

November (Figure 11). In November we have the return increase of wind frequencies from the W direction, particularly at the stations Antolowka, Lysa Polana and Witow. At Kasprowy Wierch we have the yearly maximum of the S direction.

December (Figure 12). The frequency of the directions of winds is similar to that which appeared previously. Characteristic is a very large % of the days with silence, reaching the values of the order of 69% in Chocholowska Valley.

Spring (III, IV, V, Figure 13). The analysis of maps for particular months and seasons of the year indicates a small seasonal variability. In the spring system the prevailing winds are from S and SW directions. Only Kasprowy Wierch notes a higher frequency from the N direction. Prevalence of winds from the W direction is noted at the stations Dolina Pieciu Stawow Polskich, Poronin and Pajakowka. This behavior is connected with direction of the valley axis, and in the case of Pajakowka with direction of the course of slope. On the other hand, the same direction occurring in Witow suggests that the station lies outside of the orographic influence of Tatras.

Summer (VI, VII, VIII, Figure 14). In the period of summer one can observe a reduced participation of winds from the SW direction in comparison with spring. On the other hand, there is an increase in % of days with silence.

Autumn (IX, X, XI, Figure 15). In autumn we see a renewed increase of the frequency of winds from the SW sector, with

simultaneous decrease of the participation of winds from the N direction. Otherwise the system is similar to that in previous periods.

Winter (XII, I, II, Figure 16). The winter season brings hardly any change in the distribution of frequencies of the directions of ground air currents in relation to the period of autumn. Changes vary to the extent of barely few percent, as can be seen in the attached tables.

Year. Two maps of the frequency of wind directions were prepared for the year. They are:

1) for eight directions (Figure 17),
2) for quadrants (Figure 18).

The quadrant map depicts prevailing directions, which in particular months appear in the first place. On the basis of a description of anemometric geographic points we can state with high probability that the prevailing wind directions agree with ground relief. The highest frequency is observed in open ground elevations, and the lowest in the directions protected by terrain elevations. Stations located in narrow sections of mountainous valleys have directions of prevailing winds agreeing with the valley axis, e.g., Kosne Hamry, Dolina Chocholowska, Kuznice. On the other hand, broad valleys, e.g., Witow, do not have such a decisive influence upon the wind directions.

An interesting system of wind directions prevails at Hala Ornak where not the axis of the valley, but Tomanowa pass exerts the decisive effect producing, after winds from the S, in the second place winds from quadrant E. It is a known fact that in mountaineous areas anemometric conditions are greatly influenced by local circulation of air caused by differences in heating of peaks and mountain valleys.

On the basis of tables and maps we conclude that the prevailing directions of ground air currents are S and W directions.

In general, we see a very small participation of winds from quadrant E, with exception of the above described Hala Crnak. At the stations Kasprowy Wierch and Kuznice in first place are winds from quadrant S, but in the second place are winds coming from quadrant N.

As an ending remark we want to point out that the above description is very generalized, since the author intended to find out the main reasons for the distribution of winds in the mountain area and to obtain the prevailing wind directions which are of large importance for economic reasons, in building, etc. It does not mean, however, that these are the only directions. All the detailed data, which would blur the basic features in this description, can be found in tables and maps attached to this report.

Frequency of wind velocity

Statistical material pertaining to the wind velocity was taken from compilations of Guminski, Piasecki, Orlicz, and partly Kosinska-Bartnicka, as well as own material for Hala Gasienicowa. In this way we obtained material for wind velocity for the following altitude levels (storeys):

1) Zakopane - located at altitude 835 m above sea level, representing conditions in Row Podtatrzanski,
2) Hala Gasienicowa - located at altitude 1520 m a.s.l., representing conditions in the middle height zone,
3) Kasprowy Wierch - located at altitude 1988 m a.s.l., representing peak parts of Tatras,
4) Lomnica - located at altitude 2635 m a.s.l., completing the available anemometric observations for Tatras.

The statistical material for velocities was treated in two ways: for Zakopane and Hala Gasienicowa according to criteria of Hellman and then Bartnicki and Guminski, but materials for Kasprowy

Wierch and Lomnica are treated in a somewhat different way - comparison of 13-degree Beaufort scale with adopted division into degrees of velocity in m/sec.

Division according to Hellmann	on Beaufort scale,	according to Orlicz
0—2 m/sec	0—1 m/sec	0—1 m/sec
2—5 „	2—3 „	2—5 „
5—10 „	4—5 „	6—9 „
10—15 „	6—7 „	10—15 „
15— „	8—9 „	16—22 „
	10—12 „	22 „

Zakopane. The highest frequency of winds occurs within limits 0-2 m/sec. About 50% observations are found in this range. The maximum of frequencies for this first division occurs in January (52.9%), and the minimum in May (42.5%). In second place, in turn, are winds with velocities 2-5 m/sec. The maximum of this second division occurs in July (33.0%), and the minimum in November (20.6%). Frequency of velocities above 5 m/sec is small and does not exceed 8.7%, and for velocities above 15 m/sec reaches barely 2.2%. The maximum velocities are 20 m/sec, and the average of the highest velocities is 19 m/sec. The average yearly number of days with winds of maximum velocities is 4 days (Figure 19).

Hala Gasienicowa. Wind velocities at Hala Gasienicowa present a somewhat different picture,namely there is lack of differentiation between the first and the second division. Maximum frequency of velocities for the first division occurs in August of the order of 47%, and the minimum in January of the order of 27.6%. In January velocities of the second division

(2-5 m/sec) are higher than frequencies of the first division. Moreover, in the months from February to May the frequency of wind in division 1 is only little higher than the frequency of winds in division 2.

The fraction of winds with velocities above 5 m/sec ranges from 17.2% in January to 7.7% in July, and above 15 m/sec does not exceed values of the order of 4%. The average of maximum velocities reaches the value of 19 m/sec (similarly to Zakopane), and their annual frequency is 5 days (Figure 19).

Kasprowy Wierch. As was mentioned above, frequencies of wind velocities for Kasprowy Wierch and Lomnica were calculated in a somewhat different way than for the previous stations. It does not form, however, a real obstacle for general comparisons. Thus, for Kasprowy Wierch the most frequent are winds with velocities 6-9 m/sec in winter and autumn months, whereas from April to August the prevailing velocities are 2-5 m/sec. Maximum average velocities are noted in winter and spring months, and minimal velocities in the period of summer. The fraction of winds with velocities 15 m/sec and higher (16-22 m/sec) per year on the average is 6.6%, also predominantly in winter time.

Moreover, Orlicz has winds with velocities above 22 m/sec whose fraction per year is of the order of 2.0%. The number of days with wind velocities above 25 m/sec was 48 days in 1938. The highest wind velocity noted so far is above 60 m/sec.

Lomnica. The most frequently noted winds at Lomnica have velocities 2-5 m/sec. Their participation per year is described by the number 42.8%. The frequency of appearance of higher velocities is lower than at Kasprowy Wierch: for division 16-22 m/sec is 2.3%, and for velocities above 22 m/sec - only 0.5%. According to Orlicz, the maximal wind velocities reach values above 50 m/sec (years 1941-44, 1947-48). The absolute maximum wind velocity is 69 m/sec.

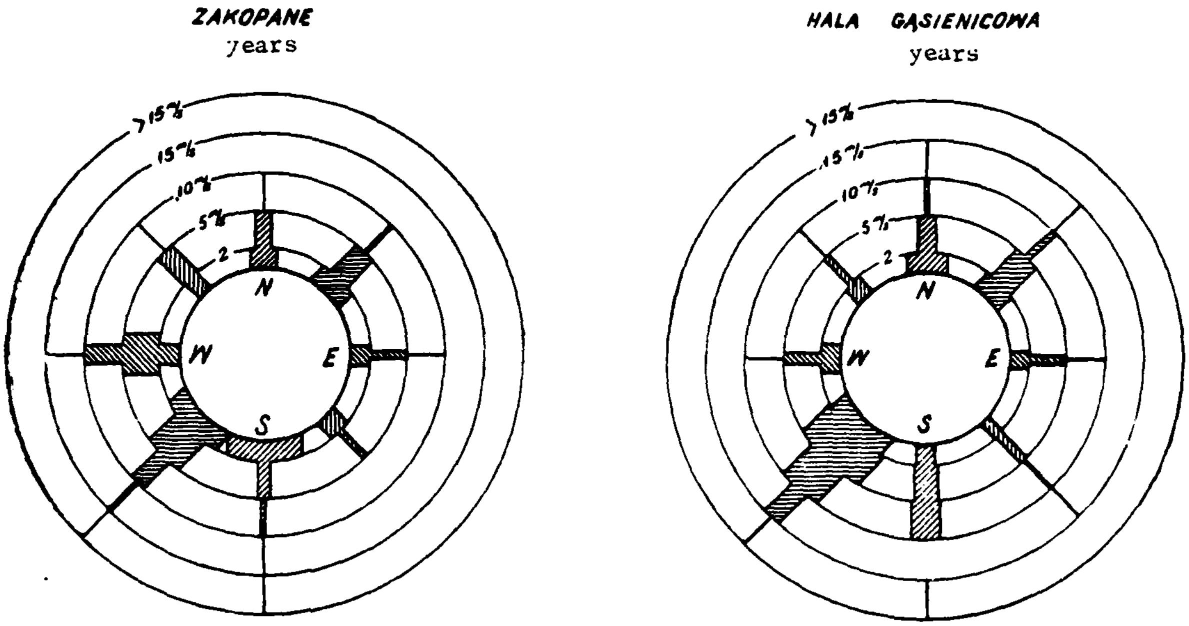

Figure 19. Graphical representation of the frequency of wind velocities in %% (by the method of Okolowicz)

<u>General characteristics of wind velocities</u>

In the zone up to 1000 m winds with velocities from 0 to 2 m/sec are prevailing. Participation of winds with high velocities above 15 m/sec does not exceed 2.3%, and maximum velocities range from 17 to 20 m/sec.

In the altitude zone up to 1520 m there is an increase in frequency of winds with velocities 2-5 m/sec. One can note also a larger frequency of winds with high velocities, above 15 m/sec, to values of the order of 17.2%. Maximum velocities are similar to those in the previous zone. However, wind velocities are too low because observations were made using a Wild anemometer with the normal plate weight, i.e. 200 g. The actual values are probably higher.

The altitude zone up to 2000 m is characterized by a strong increase in wind velocities. Prevailing winds have velocities of 2-5 m/sec and 6-9 m/sec in equal amounts. The frequency of velocities from 16 to 22 m/sec is 6.6% per year, and of velocities above 22 m/sec - 2.0%.

In the high altitude zone up to 2600 m (2635), there is a decrease in wind velocities. Most frequent are winds with velocities of 2-5 m/sec, similarly to the second zone (to 1520 m). Air currents with velocities of 16-22 m/sec do not exceed 2.3% per year, and with velocities above 22 m/sec - only 0.5%.

It follows from the above that wind velocities increase to an altitude of 2000 m (Kasprowy Wierch) and then begin to decrease. The phenomenon of an increase in certain meteorological factors in high mountains only to a certain level is known, in relation to temperatures and rainfall. Could the same considerations apply to wind velocities? Or perhaps local topographic conditions only affect this phenomenon?

Instead of giving answers to these questions it appears appropriate to investigate wind velocity in free atmospheres. Even though the results cannot be applied directly to mountain regions, nevertheless they can throw some light on the whole problem.

The study of wind velocity as a function of altitude was done, among others, by Assmann [1], on the basis of data collected by the Aeronautical Observatory in Lindenberg. He compared wind velocities for the following altitudes above sea level: 122 m, 500 m, 1000 m, 1500 m, 2000 m, 2500 m, 3000 m, 3500 m, and 4000 m. On the basis of material calculated for the period 1903-1907, it is obvious that the wind velocity increases with an altitude increase, as is shown by the table given below.

Division of velocity	500 m	1000 m	1500 m	2000 m	2500 m	3000 m	3500 m	4000 m
0 – 2	8.8	9,0	9,3	8,1	7,5	6,1	6,0	4,8
2 – 5	19,4	18,3	16,8	12,1	9,4	8,3	7.2	4.8
5—10	37,0	33,6	28,4	26.5	20,4	18,0	14,1	11.0
10—15	18.7	22,5	27,4	32,0	34,3	30,9	26,8	21,3
15	13,2	14,6	14,8	17,6	24,6	32.4	42,3	55,0

In light of material of the Observatory in Lindenberg the problem of reduced wind velocity at Lomnica as compared with Kasprowy Wierch could be explained by two possibilities:

1) air streams flowing over Kasprowy Wierch become convergent, and it results in an increase of wind velocity,
2) lower wind velocities in the peak parts of Tatras are caused by turbulence and a higher coefficient of friction over uneven ground base.

<u>Number of days with silence in %</u>

Characterization of velocity of the ground air currents includes also observation of silence, that is, those conditions at which the velocity of air movement does not exceed 0.5 m/sec. Over the discussed area the frequency of days with silence in % comprises a very wide range of numbers - from 2.1% (Myslenickie Turnie) to 47.3% (Dolina Chocholowska). Here one can separate these forms of terrain which without doubt have an effect on the frequency of silence. Hence, the following groups of stations were made, depending on their location.

Compilation of data on silence, given below, suggests a dependence between the form of ground and the frequency of

(1) Nazwa stacji	Liczba obserwacji [illegible] w [illegible] (2)
(3) **I. Stacje dolinne** (obejmują również formy wklęsłe, niecki i kotły polodowcowe)	
1. Dolina Chochołowska	47,3
2. Dolina Pięciu Stawów Polskich	13,7
3. Hala Gąsienicowa	14,5
4. Hala Ornak	45,5
5. Kuźnice	36,6
6. Morskie Oko	45,9
7. Poronin	31,8
8. Witów	31,0
(4) **II. Stacje Rowu Podtatrzańskiego**	
1. Antolówka	29,7
2. Zakopane (okr. II)	39,3
(5) **III. Stacje zboczowe**	
1. Głodówka	17,6
2. Gubałówka—Pająkówka	35,5
3. Łysa Polana	24,4
4. Bukowina	29,4
(6) **IV. Stacje szczytowe i grzbietowe**	
1. Kasprowy Wierch	3,6
2. Myślenickie Turnie	2,1

1 - Name of station; 2 - Number of observed days with silence (year); 3 - Valley stations (including also trenches, troughs and post-glacial bowls); 4 - Stations of Row Podtatrzanski; 5 - Slope stations; 6 - Peak and ridge stations.

occurrence of silence. The most suitable areas for the occurrence of silence are valleys and other concave forms, whereas the peak and ridge stations have a minimum number of days of silence. Out of eight stations of Group I, six show similar values for silence. Two stations - Dolina Pieciu Stawow Polskich and Hala Gasienicowa - give much smaller values because of a greater draught of the valleys.

Meteorological stations in Row Podtatrzanski show % silence of the order of 30-40% observations in 1952-53. Antolowka which is located about 80 m higher than Zakopane notes a smaller % of silence, because of free flow of air currents. On the other hand,

observational data at Zakopane for period I differ from those given above. The reason could be either an exceptionally large number of silent days in the discussed two years (52-53), or change of the location of stations. Since there is no third station which could serve for comparison with the two previous ones, the problem remains open.

Concluding remarks

The analysis of anemometric conditions in Tatras and at Podhale, on the basis of available observational material, points to only very general conclusions. In the future, these conclusions should be confirmed by longer and more uniform observational series.

1. The orography of terrain exerts the decisive influence both on the prevailing directions and also on the velocity of winds.
2. The prevailing winds have directions agreeing with the course of valleys, bowls and passes, hence they have S, SW and W directions.
3. Only small seasonal variability is observed in the frequency of wind directions at the majority of stations.
4. An increase of wind velocity with increase of altitude is observed up to about 2000 m above sea level. The highest velocities are connected usually with prevailing directions.
5. Screening of Row Podtatrzanski from Northern winds by Spisko-Gubalowskie ridge and Gorce creates favorable conditions for building sanatorium and convalescent home facilities on Southern and Southeastern slopes of Gubalowka.

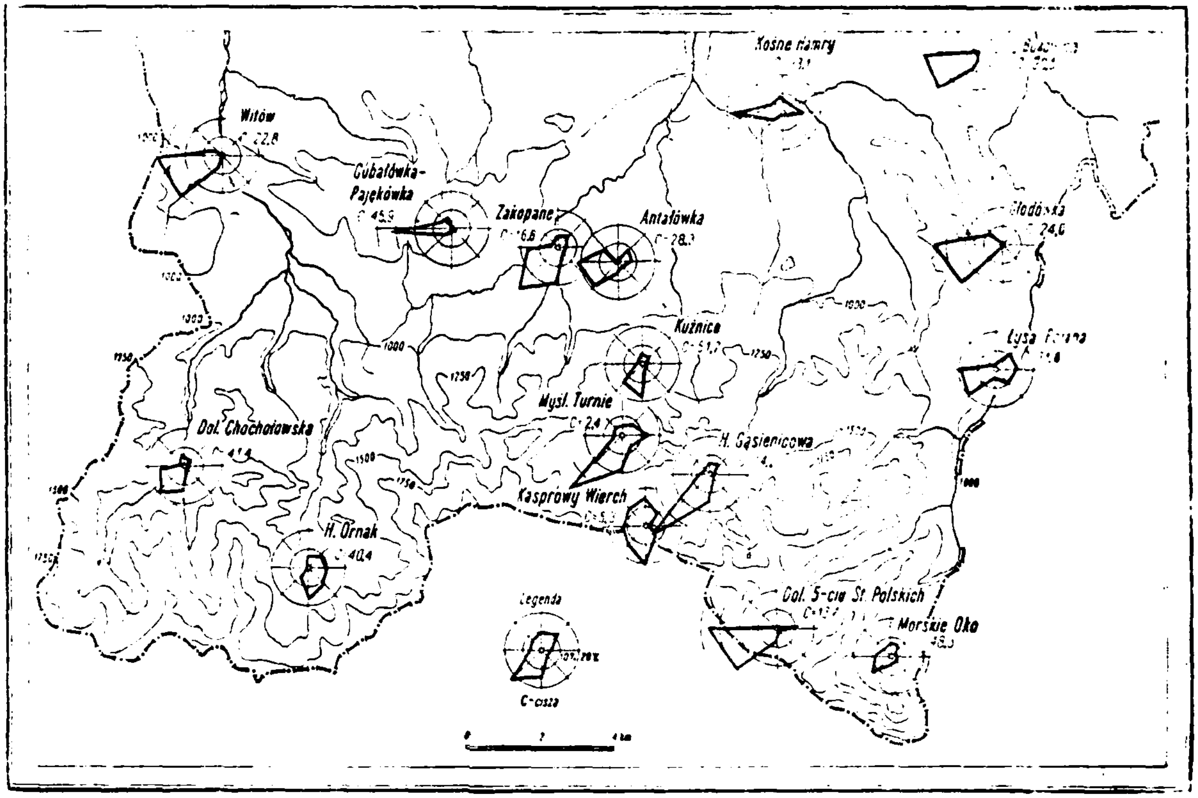

Figure 1. Frequency of ground winds in Tatras, January.

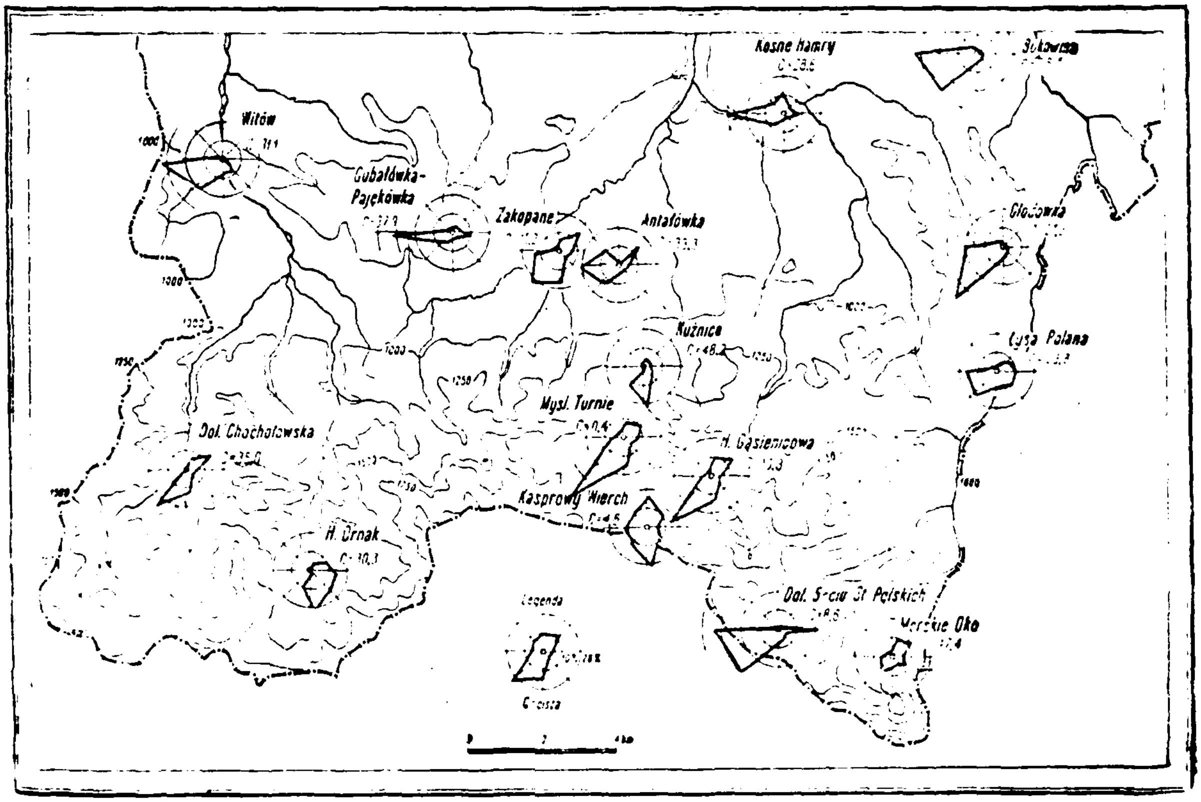

Figure 2. Frequency of ground winds in February.

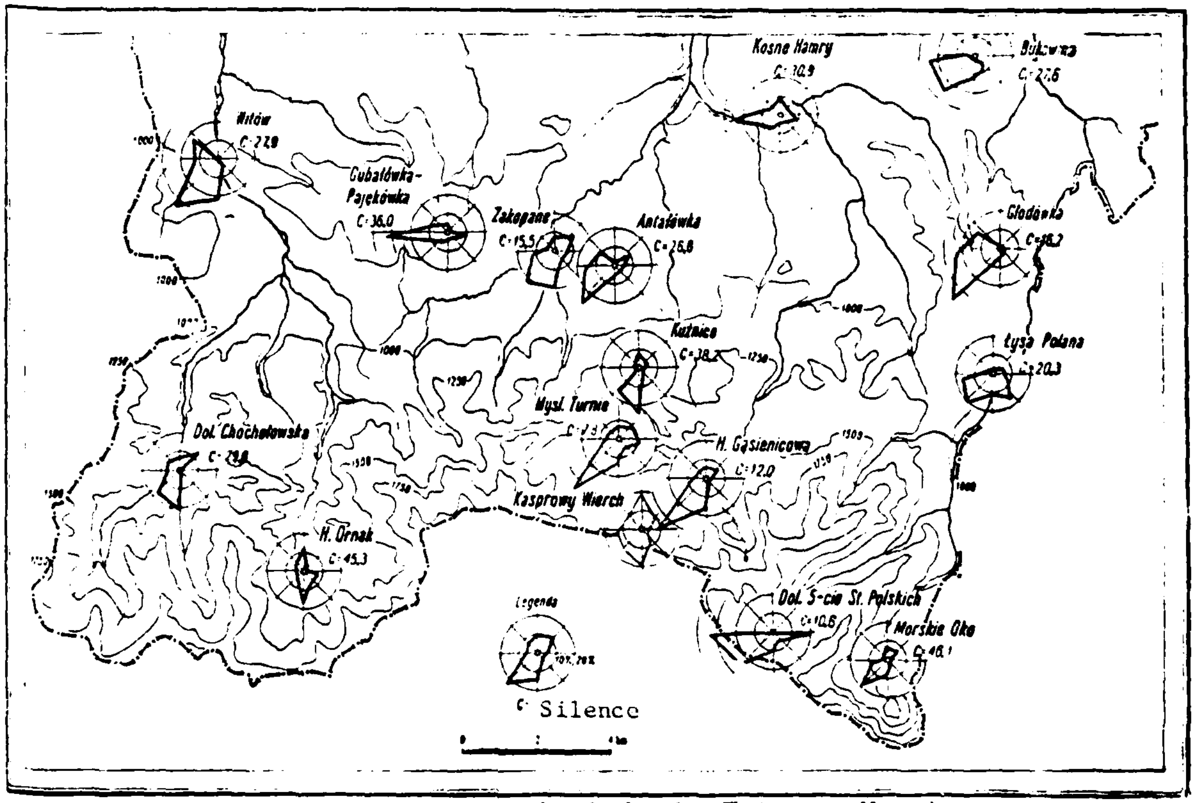

Figure 3. Frequency of ground winds in Tatras, March.

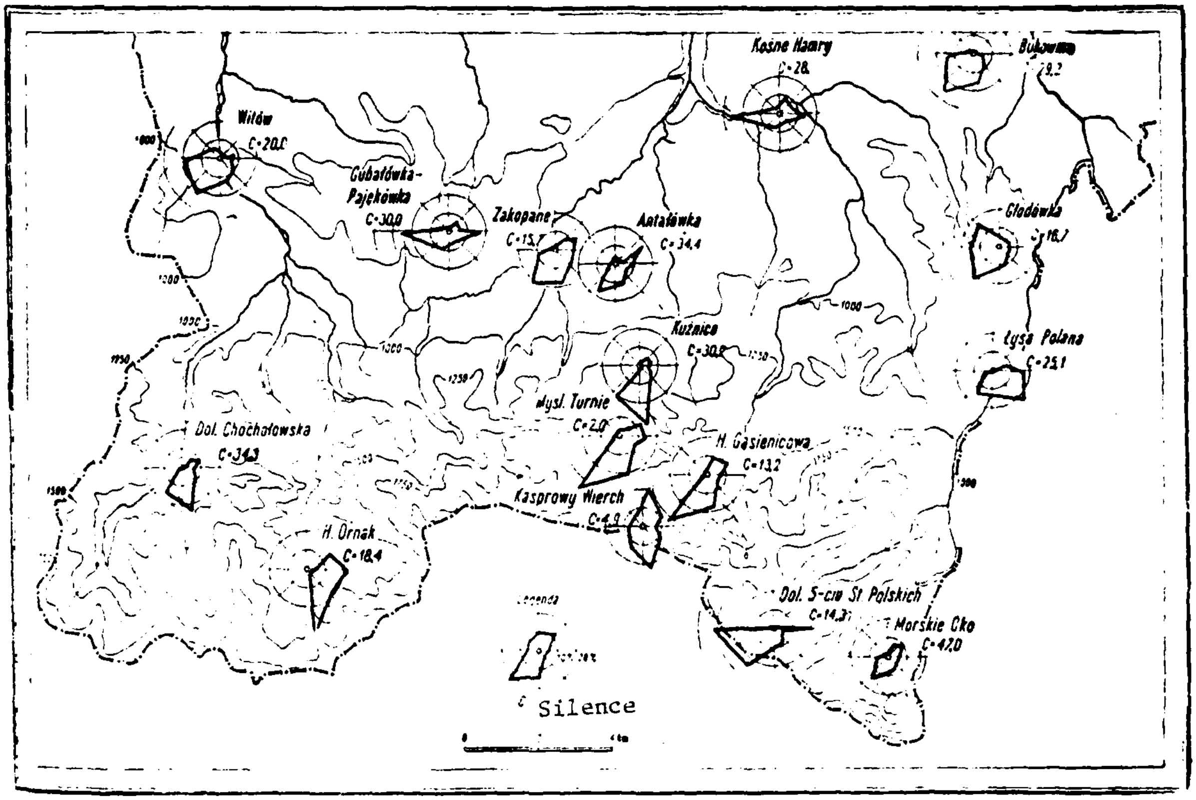

Figure 4. Frequency of ground winds in Tatras, April.

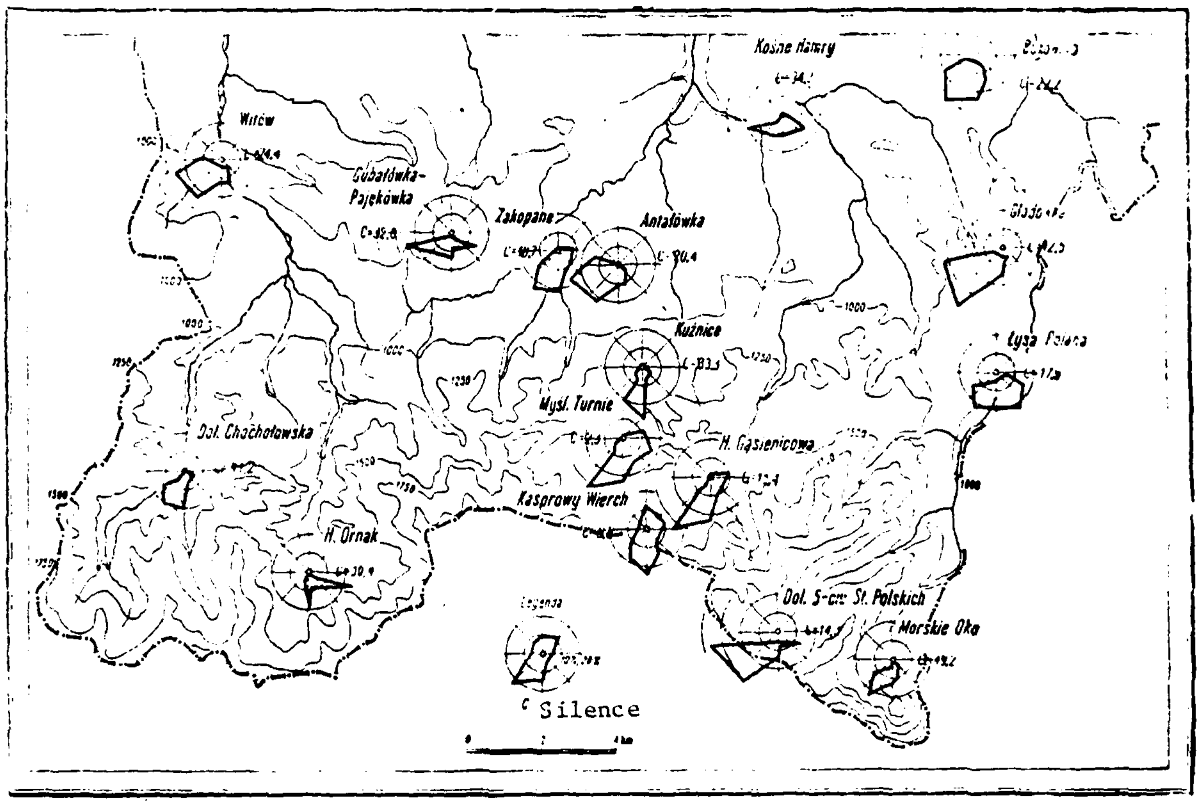

Figure 5. Frequency of ground winds in Tatras, May.

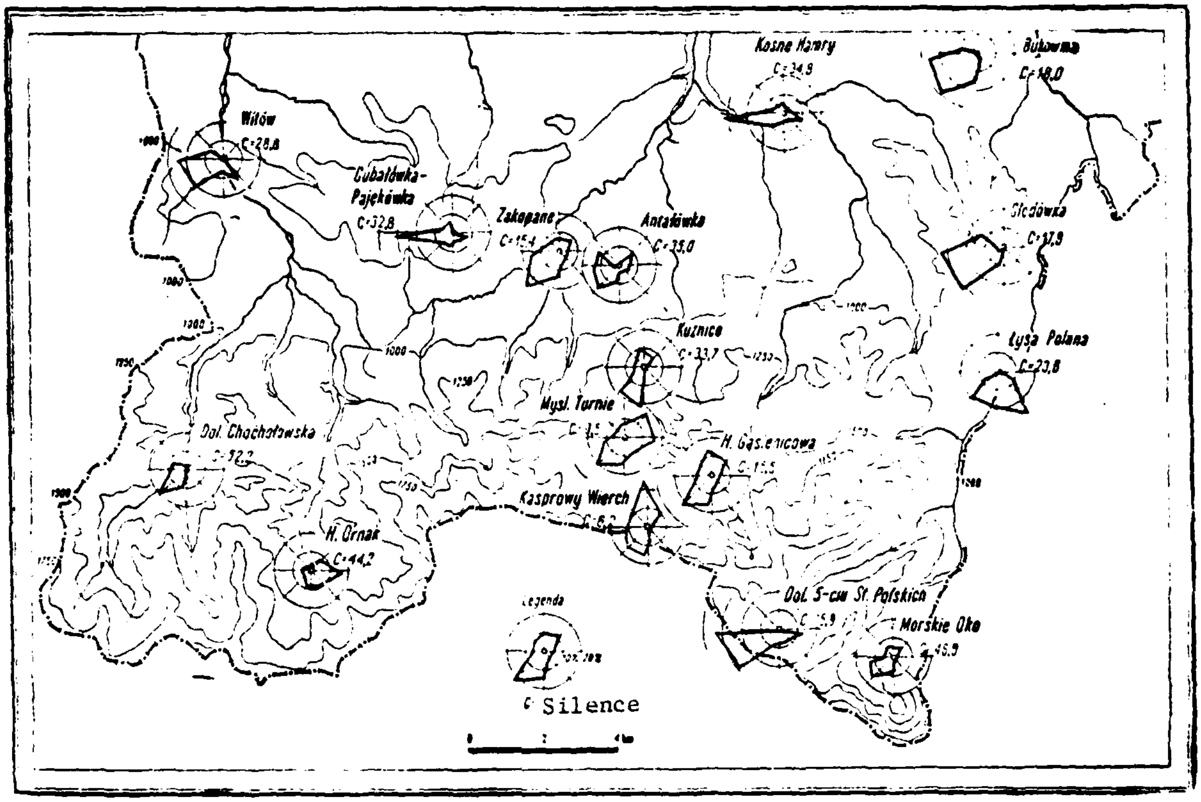

Figure 6. Frequency of ground winds in Tatras, June.

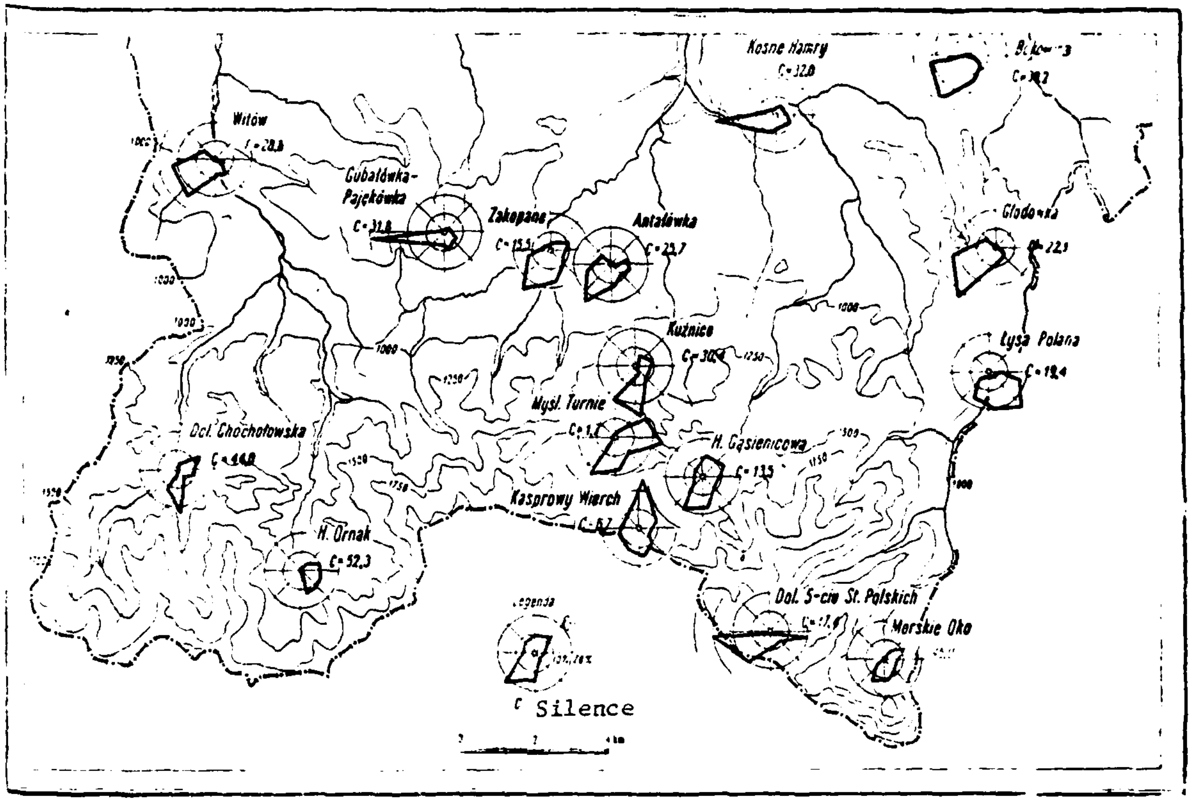

Figure 7. Frequency of ground winds in Tatras, July.

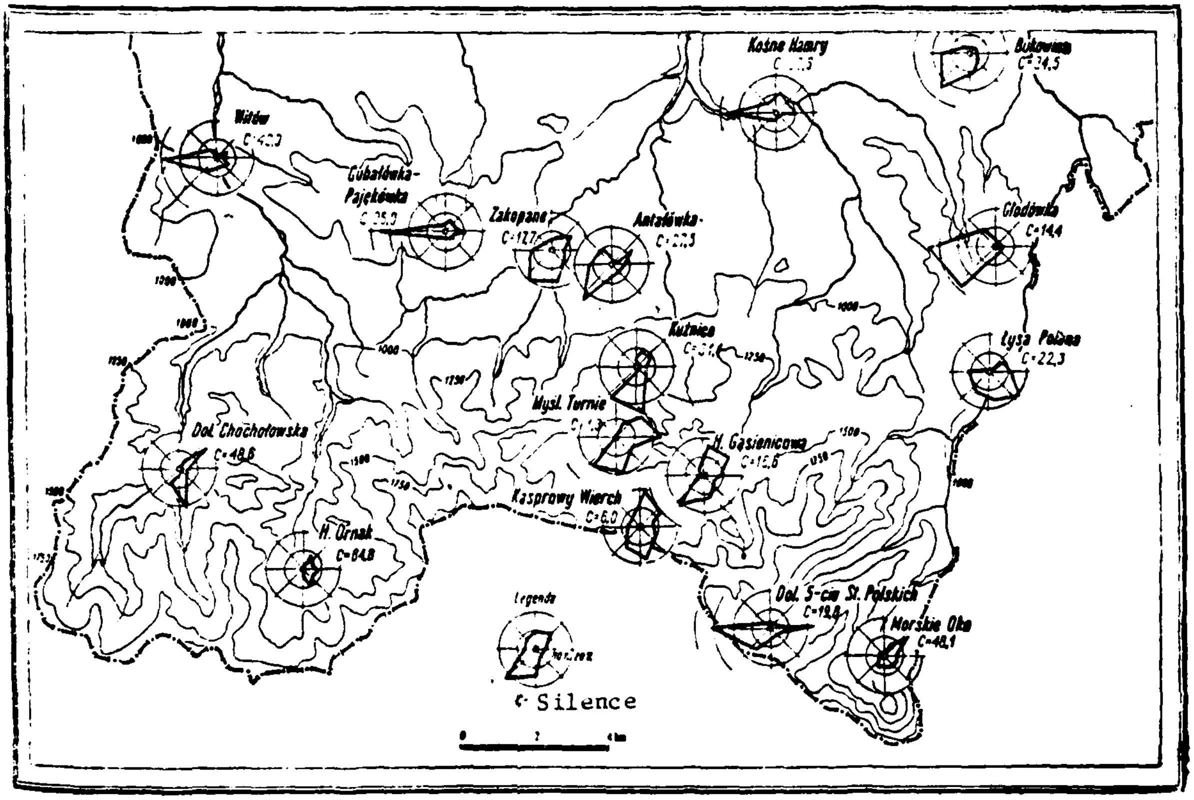

Figure 8. Frequency of ground winds in Tatras, August.

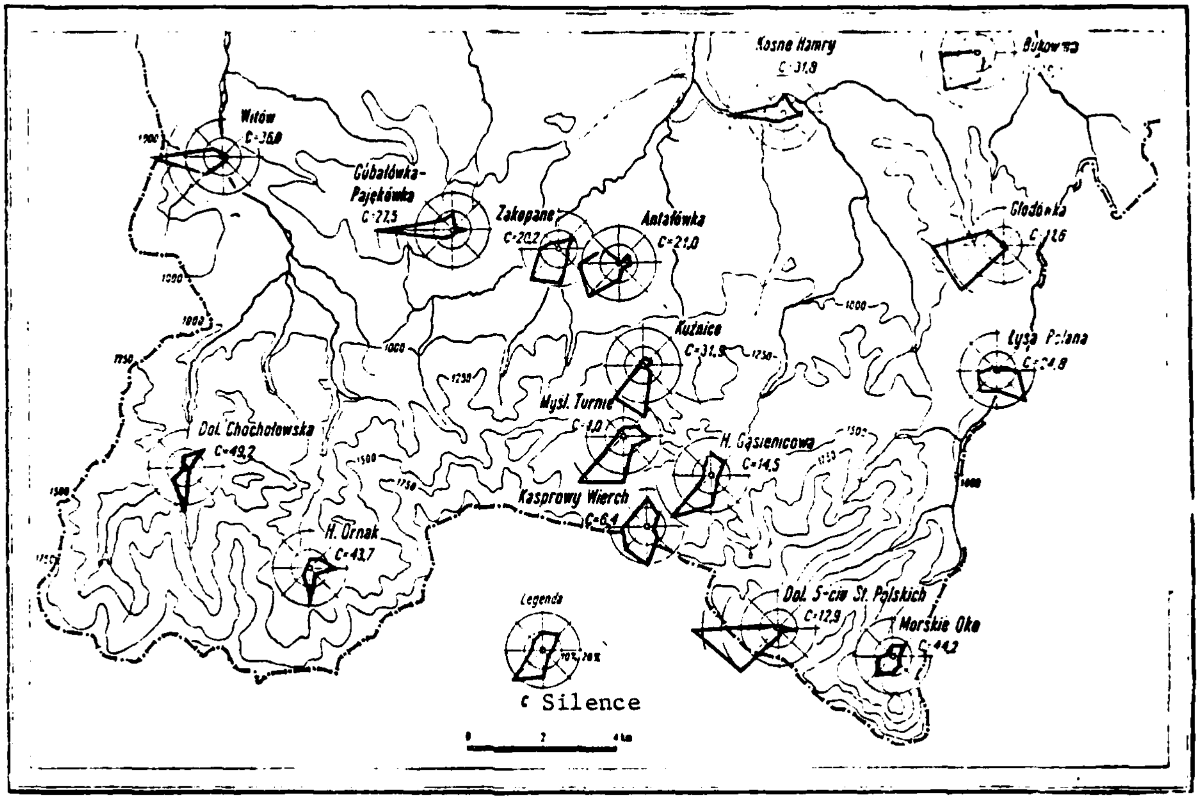

Figure 9. Frequency of ground winds in tatras, September.

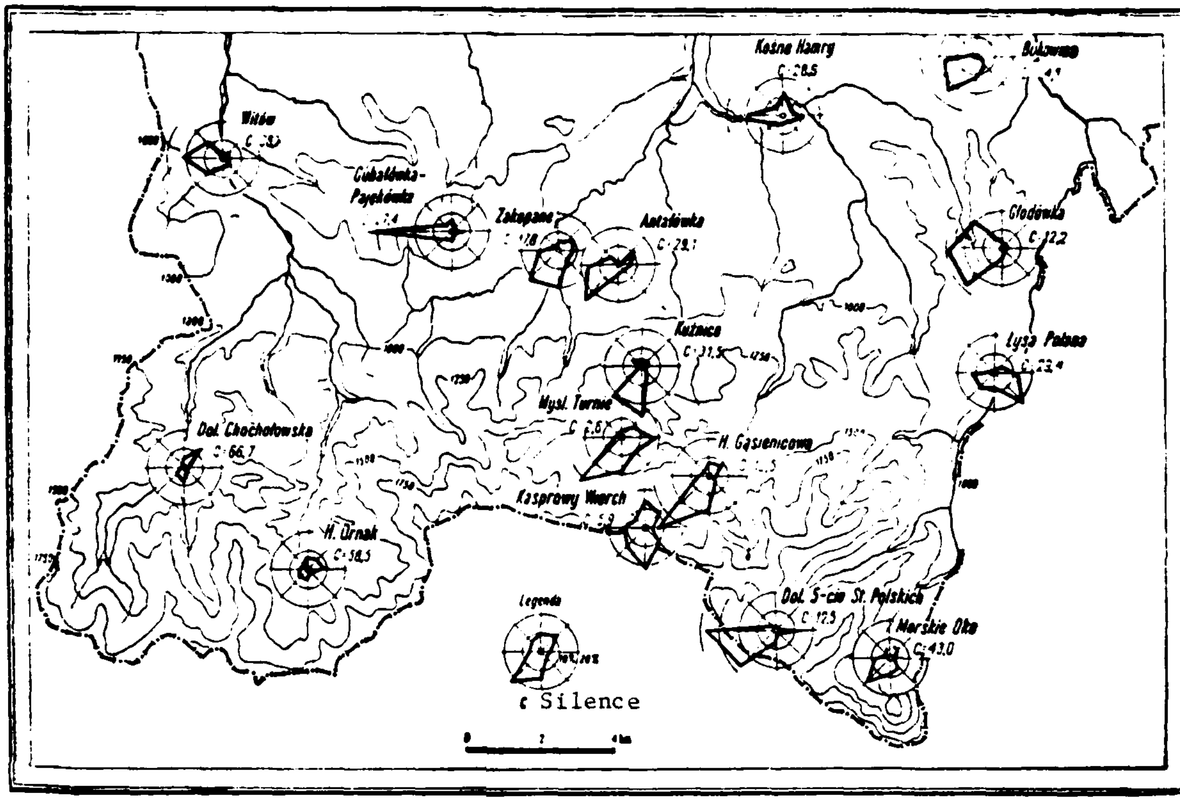

Figure 10. Frequency of ground winds in Tatras, October.

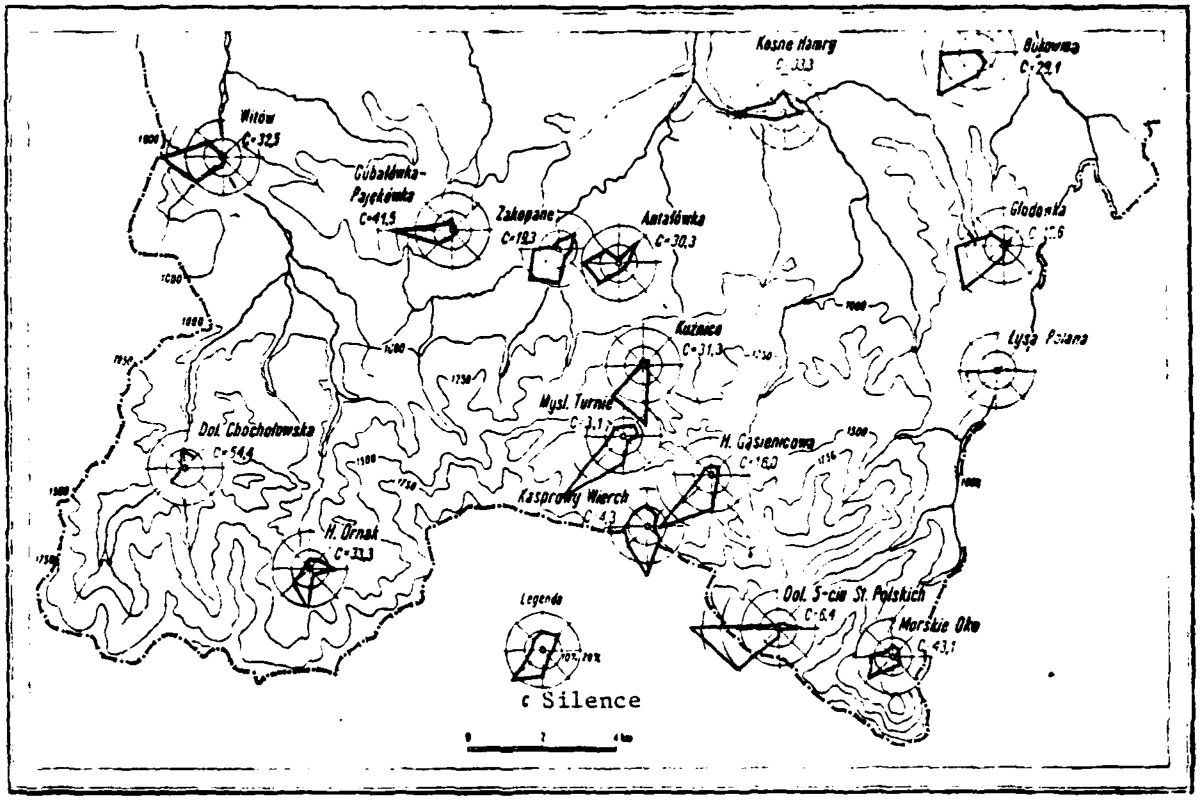

Figure 11. Frequency of ground winds in Tatras, November.

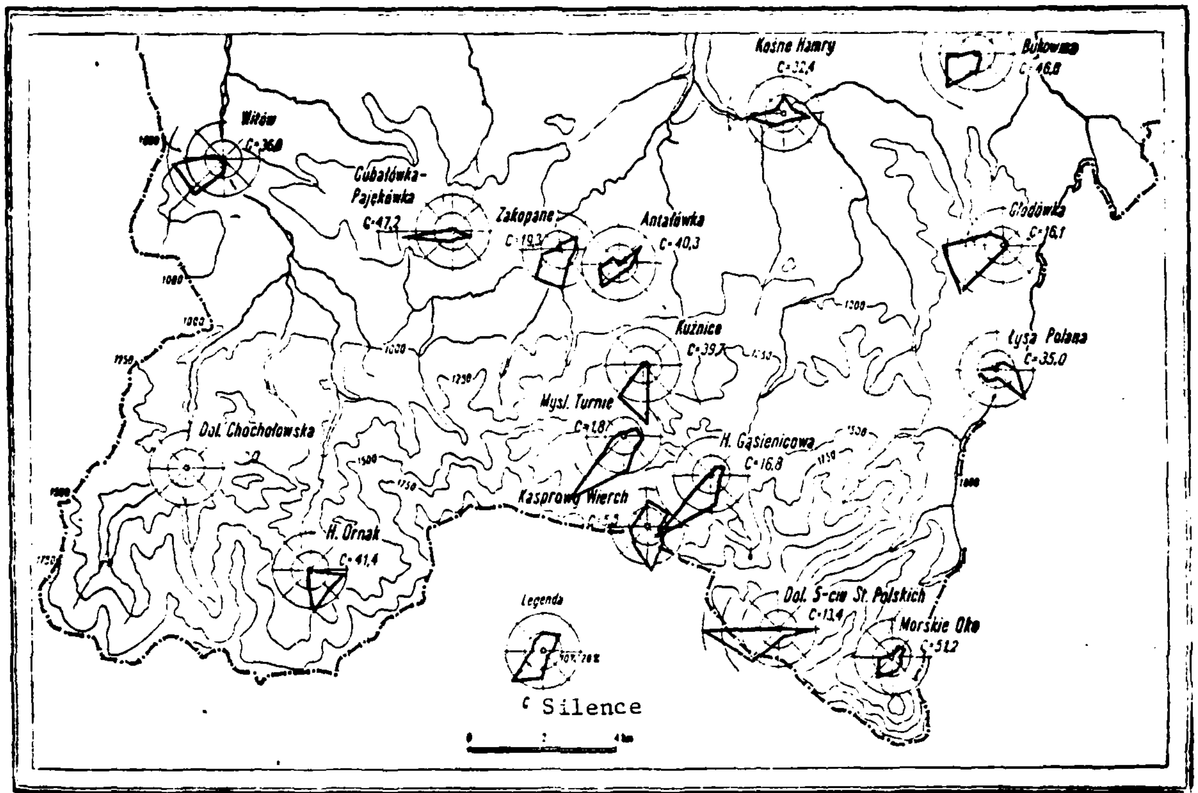

Figure 12. Frequency of ground winds in Tatras, December.

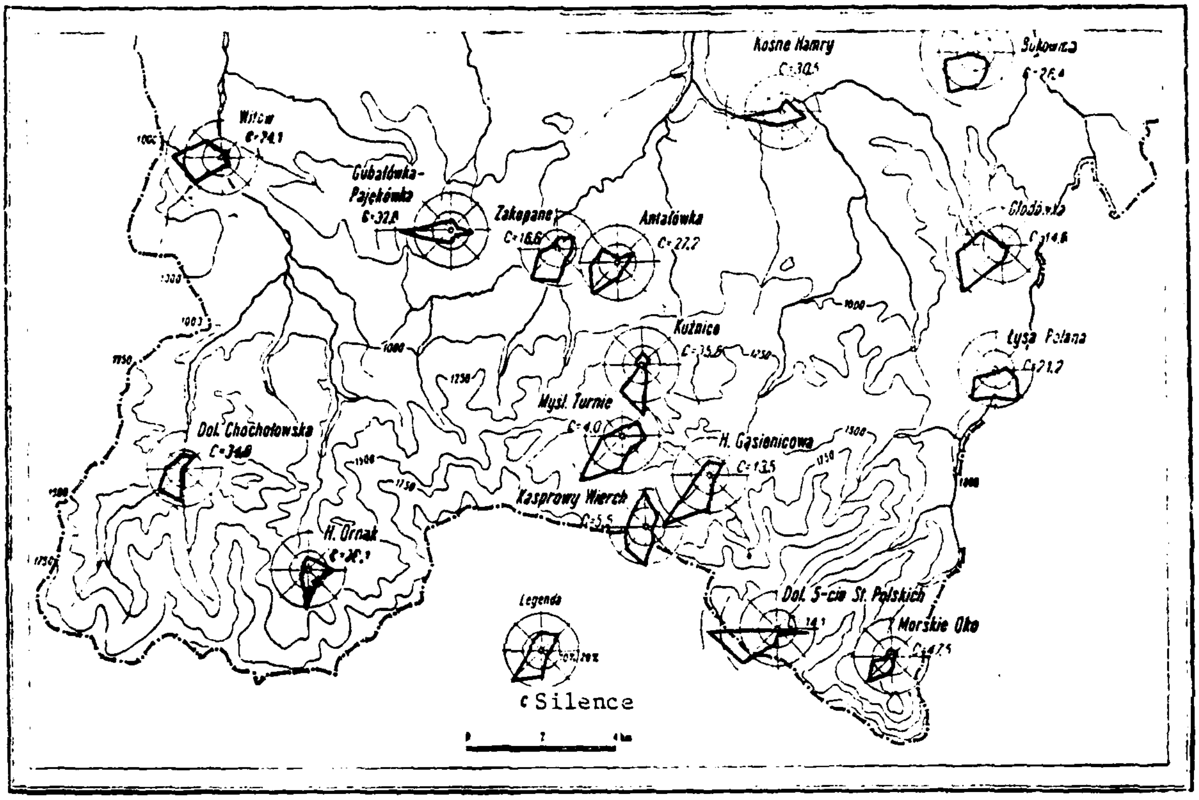

Figure 13. Frequency of ground winds in Tatras, Spring (III, IV, V).

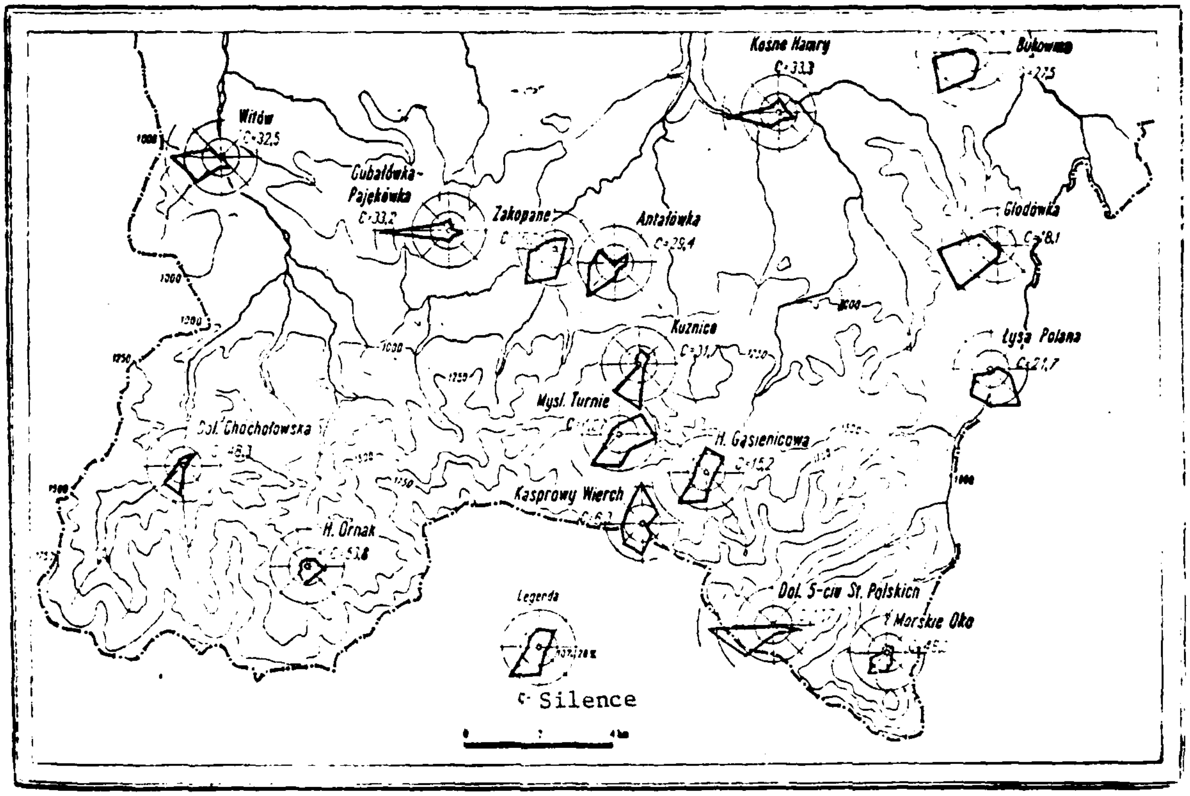

Figure 14. Frequency of ground winds in Tatras, Summer (VI, VII, VIII).

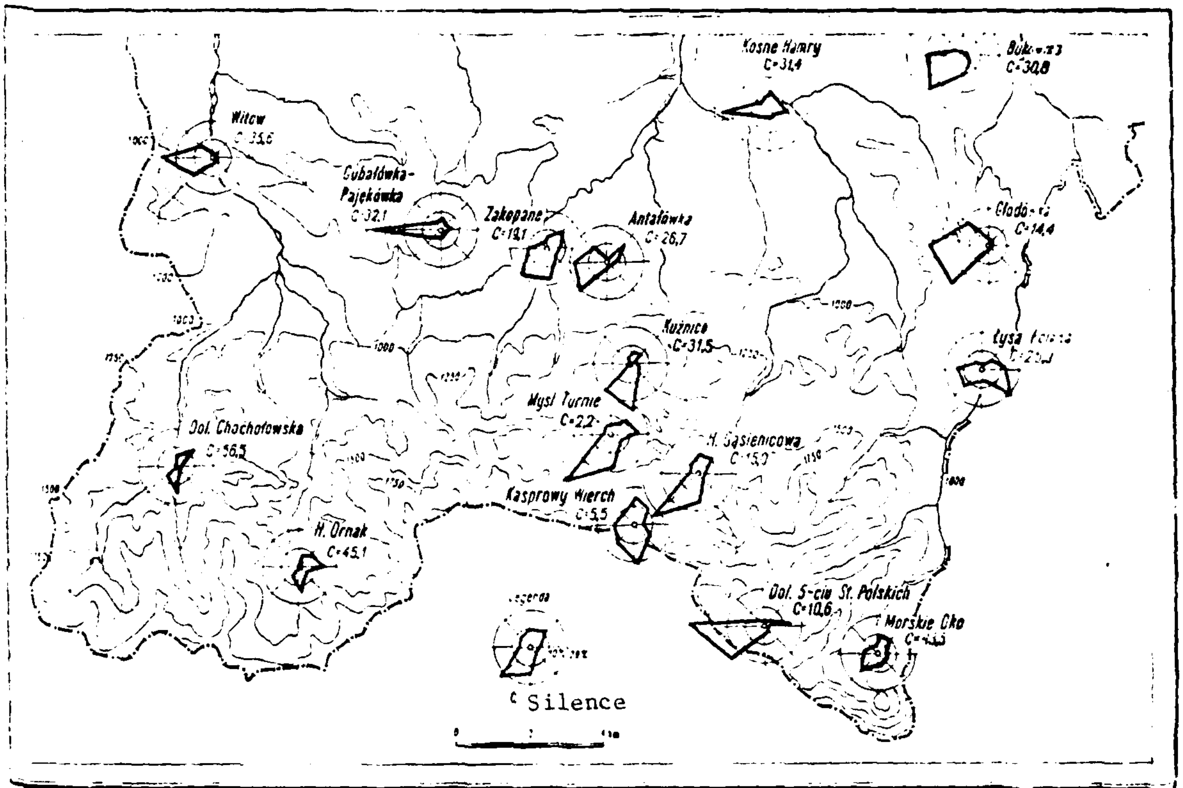

Figure 15. Frequency of ground winds in Tatras, Autumn (IX, X, XI).

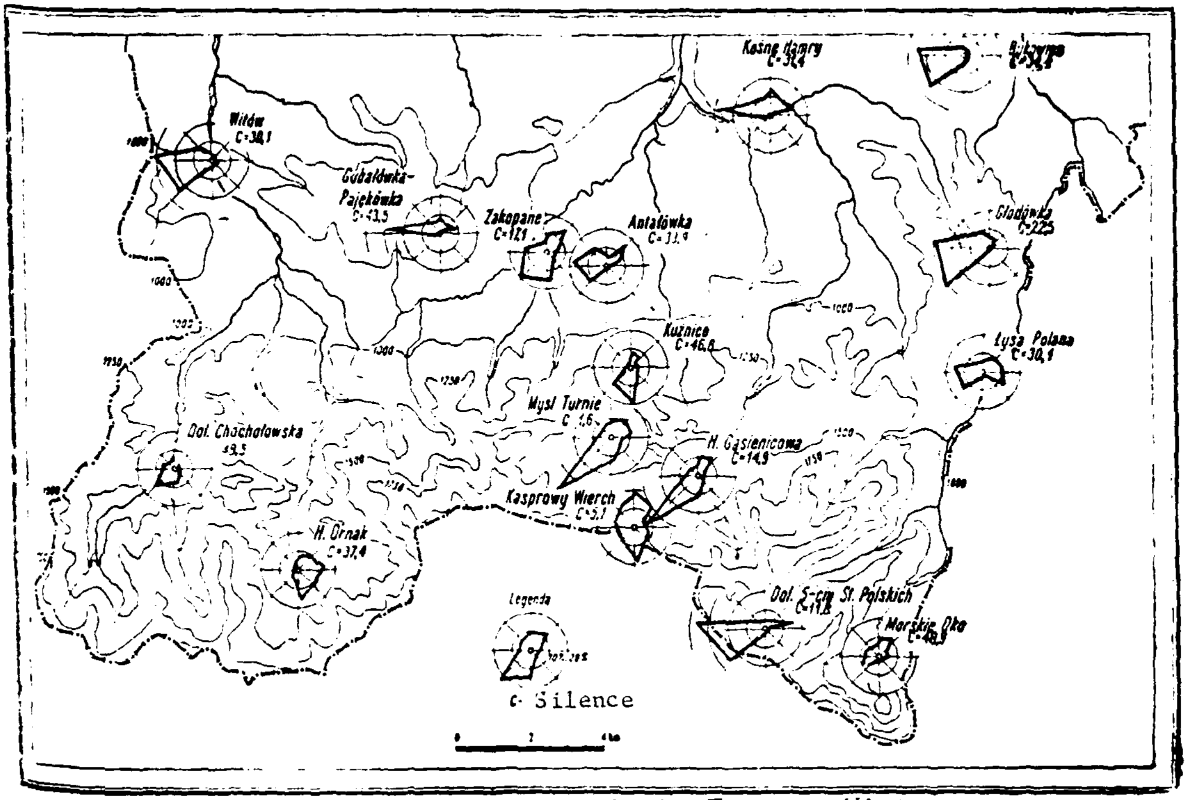

Figure 16. Frequency of ground winds in Tatras, Winter (XII, I, II).

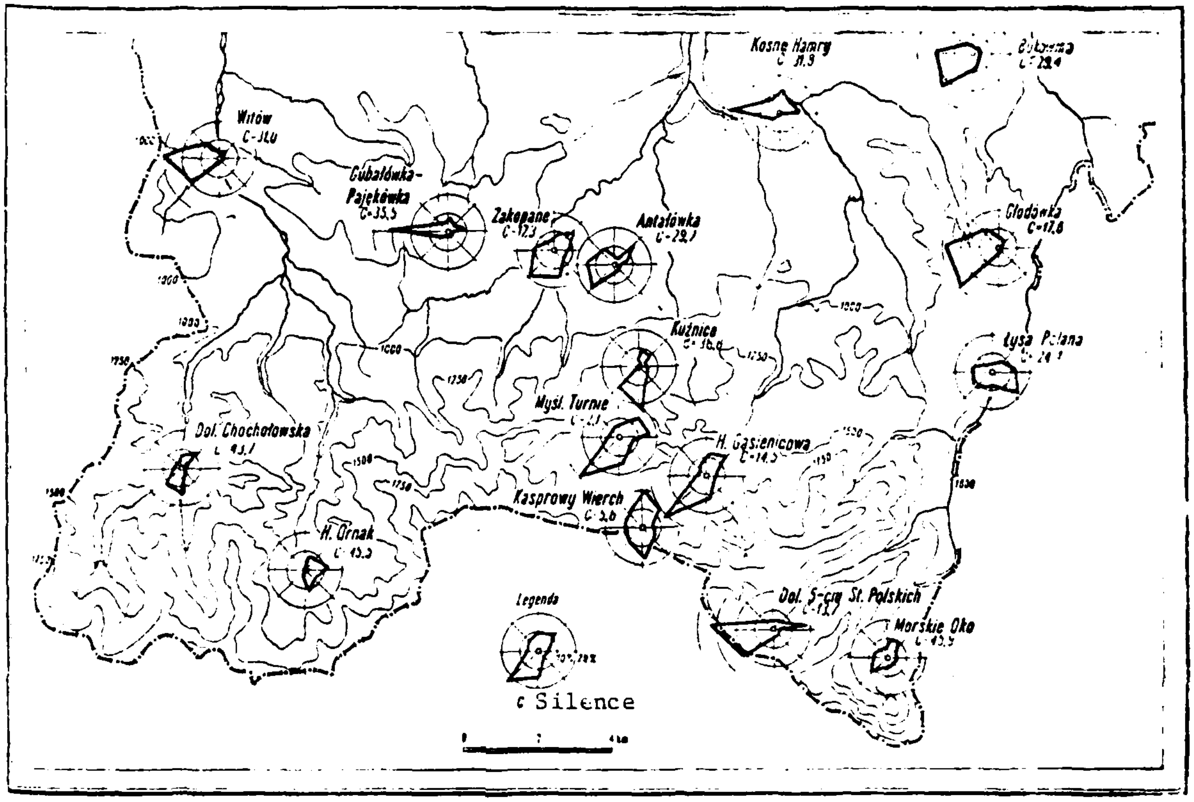

Figure 17. Frequency of ground winds in Tatras, Year.

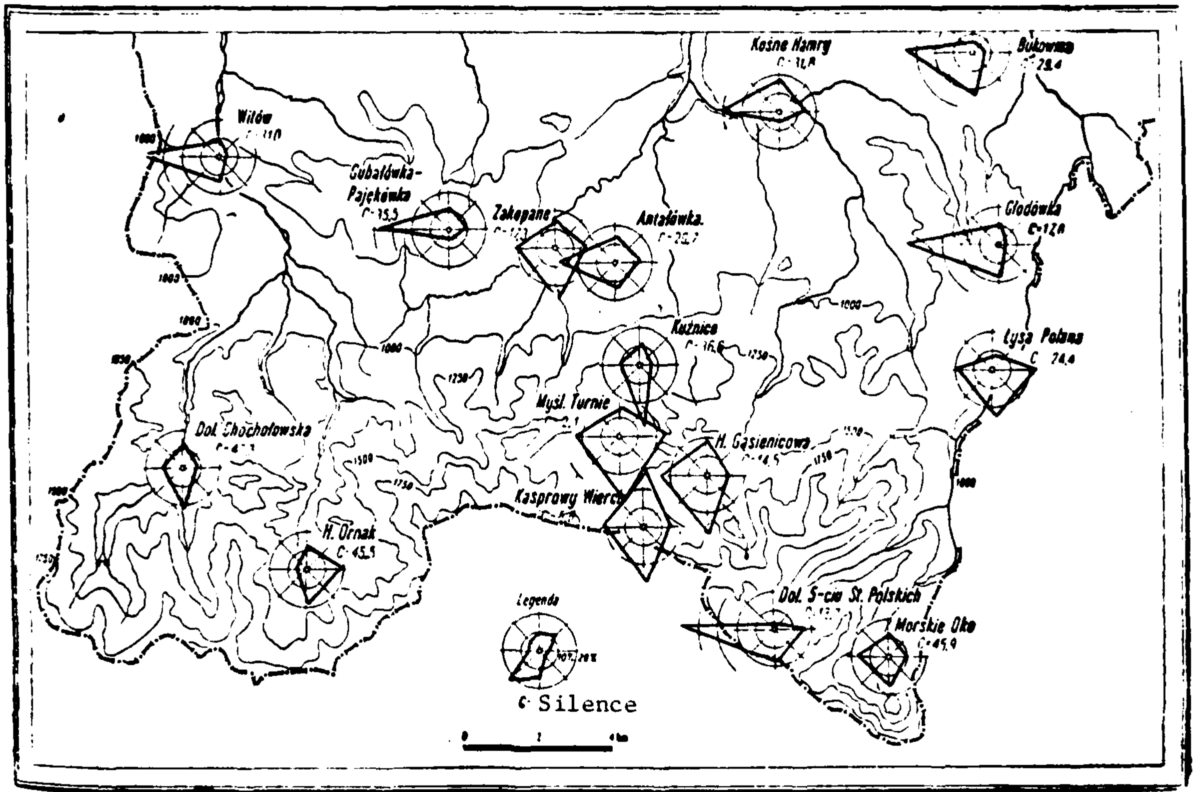

Figure 18. Frequency of ground winds in Tatras, Quadrant year.

Table 1. Frequency of wind direction in %%

Direction	N	NE	E	SE	S	SW	W	NW	C
					Antołówka 1952—53				
I	0,0	8,5	6,9	2,8	4,8	17,3	21,2	10,2	28.3
II	1,5	12,9	2.5	0.8	1,6	12,6	22,3	12,5	33,3
III	4,6	10,5	3,7	0,0	2,8	23,7	15,8	12,3	26,6
IV	1,7	15,8	3.6	2,2	9,2	18,1	7,5	7,5	34,4
V	6.4	5,9	3,8	4 3	3,2	16.2	22,6	17,2	20,4
VI	1,1	12,5	5,9	0.8	5,9	14,2	11,6	13.0	35,0
VII	1.2	7.9	6.7	2,7	6,4	23,6	15,2	10,6	25,7
VIII	0,5	10,2	3,8	2,2	3,3	25,2	15,2	12,1	27,5
XI	1,4	7.5	4,4	C,6	6,1	23,1	22,6	13.3	21.9
X	0,8	11,5	4,3	2,2	2,9	26,0	16,2	7.0	29,1
IX	0,3	15,0	4.7	3.6	3,6	14,2	18,8	9,8	30,0
XII	0,6	15,3	5,9	2,4	2.7	14,0	12,3	6.5	40,3
year	1,5	11,9	4,5	1,9	4,3	19,2	16,3	10.7	29,7
year									
quadrant year	2,8		11,4		14,9		31,2		29.7
spring	4.2	10.7	3,7	2.1	5.1	19,3	15.3	12.4	27,2
summer	0.9	10,2	5.5	1,9	5,2	21.0	14,0	11.9	29,4
autumn	0,8	11.3	4,5	2,1	4,2	21,1	19,2	10,1	26.7
winter	0,7	12.2	5,1	2,1	3,0	14,7	13.6	9.8	33.9
					Bukowina 1949—53				
I	0,7	0,7	1,9	3,4	7,6	26.6	26,8	1,8	30,5
II	0,6	0.6	0.5	1,5	4.1	28.2	34,4	4.1	26.0
III	1,1	1,8	3,2	5.3	8,6	22.0	24,4	6.0	27,6
IV	1,3	2,3	1,8	3,8	12,7	25.4	17.3	6.2	29.2
V	3,1	2.5	4,5	7,1	15.4	22,2	15,7	7,3	22,2
VI	3.1	1,8	2,6	3.9	11.9	25,6	25,3	7.8	18,0
VII	1.7	0,6	1.3	1,9	8,0	26,8	23,0	6.5	30,2
VIII	2,4	0,9	1,0	2.9	9,4	25.0	17,7	6.5	34.5
IX	2,1	1.6	1,4	3,3	12,5	25.6	20.0	4.4	29.1
X	2,2	2,1	3,2	3,9	8,5	22,7	17,7	5.6	34,1
XI	0.6	0.3	1,4	4,6	11,5	30,0	21.0	1,5	29.1
XII	0,5	0,7	1,6	1,5	7,9	23.0	16,3	1,9	46,6
year	1,7	1,4	2,2	3,7	9,8	25,3	21.4	5.1	29,4
year									
quadrant year	5,0		4.7		24,3		36.6		29,4
spring	1,8	2.2	3,2	5.4	12,2	23,2	19,1	6,5	26,4
summer	2,4	1,1	1.6	2,9	9,8	25,0	22.8	6,9	27,5
autumn	1,6	1,3	2,0	3,9	10,8	26,1	19,6	3,9	30,8
winter	0,6	0,7	1,3	2,1	6,5	25.9	25.9	2.6	34,4

Dolina Chocnołowska 1951—53

I	8,5	5,7	0.0	0,3	10,8	16,8	12,7	3,8	41,4
II	8,6	14,5	0,4	0,5	9,1	24,0	4,2	3,7	35,0
III	8.8	12,9	0,9	1,2	19,5	14.9	5,7	7.1	29,0
IV	5,6	7,9	0,8	1,9	22,3	17,8	7,5	1,9	34.3
V	6,8	7,0	1,1	1,4	13,5	14.5	10,7	3,8	41,2
VI	3,9	5,4	1,1	2,1	7,2	15,7	6,3	6,1	52,2
VII	5.1	12,7	5,8	0,8	19,9	8.6	1,7	1.4	44,0
VIII	3,6	15,0	1,8	1,2	19,5	9,9	0,4	0,0	48,6
IX	6.3	13,3	1,4	0,5	21,3	7,4	0,6	0,0	49,2
X	3,5	12,8	1,6	0,0	9,0	5,9	0,5	0,0	66,7
XI	9,3	8,5	0,5	1,1	17,4	8,3	0,5	0.0	54,4
XII	5,8	3,9	0,0	2.2	8,9	9,9	0,0	0,4	69,0
year	6.2	10,0	1,4	1,0	14,9	12.4	4.4	2,4	47,3
year									
quadrant year	12,4		6,9		21,6		11,8		47,3
spring	7,1	9,2	0,9	1,5	18,5	15,8	8,0	4,2	34,8
summer	4,2	11,0	2,9	1,4	15,5	11,4	2,8	2,5	48,3
autumn	6,3	11,6	1,2	0,6	15,9	7,3	0,6	0,0	56,5
winter	7,6	8,0	0,2	1,0	9,6	16,9	5,6	2,6	48,5

Direction	N	NE	E	SE	S	SW	W	NW	C
Dolina Pięciu Stawów Polskich 1950—53									
I	0,3	0,3	11,2	2.0	7,1	30.1	35,6	0,0	13.4
II	0,3	0,0	16,2	1,6	4.5	31.5	27,0	0,3	8.6
III	0.0	0.3	23,4	3,2	7,5	22.0	33.0	--	10,6
IV	0,5	0,8	14,1	0,3	6,3	26,1	36.9	0,7	14,3
V	0.3	0,2	16,1	1,1	5.7	23,4	36,0	—	17.2
VI	0,3	0,8	15.0	6,1	4,7	25,0	31,8	0,4	15.9
VII	1,9	1,2	18,3	2,6	3,4	18,3	34.2	2,7	17,4
VIII	0,8	1.9	16,2	2,8	3,3	16,3	36,5	2,6	19.6
IX	0.8	0.0	7,3	0,8	2.8	29.9	45.0	0.5	12,9
X	2,8	0,5	13,3	0.8	6,3	25,0	36,4	2,4	12.5
XI	0,3	0,1	9,9	1.1	5,0	31,0	45,4	0,8	6.4
XII	0,5	0,4	13,3	3.4	3,4	22,7	42.9	0.0	13,4
year	0.8	0,6	14,3	2,0	5,3	25.0	37.5	0.8	13,7
year									
Quadrant year	1,5		15,6		18,8		50.4		13,7
spring	0,3	0,4	17,9	1.5	6.5	23.8	35,3	0.2	14,1
summer	1,0	1,3	16,5	3,8	3,8	19,8	34.2	1,9	17.7
autumn	1,3	0,2	10,2	0,9	4,7	28,6	42,3	1,2	10,6
winter	0,4	0.2	13,5	2.3	5,0	28,1	38,5	0,2	11.8

Głodówka 1951—53

I	0,4	0,4	0,0	0,7	2,2	28,8	35,3	8,2	24,0
II	1,1	0,7	0,7	1,4	4,3	38,3	22,1	4,1	27,3
III	4,0	4,0	0,5	0,5	0,5	33,4	23,4	17,5	16,2
IV	5,3	5,0	2,8	3,3	8,1	22,0	18,0	18,8	16,7
V	2,7	3,8	0,9	0,4	5,7	33,2	31,6	9,2	12,5
VI	1,3	2,8	—	0,5	4,5	27,0	31,6	14,5	17,8
VII	3,0	1,6	1,6	0,0	2,6	31,2	26,6	11,3	22,1
VIII	0,5	0,4	0,4	0,7	1,9	30,0	39,0	12,7	14,4
IX	0,9	1,1	0,0	0,0	1,3	33,3	39,2	12,6	11,6
X	5,8	3,8	0,4	0,7	0,0	26,2	28,6	22,9	12,2
XI	2,4	4,1	1,1	1,5	4,8	30,6	25,5	10,4	19,6
XII	3,8	2,7	0,0	0,4	0,7	32,6	33,1	10,6	16,1
year	2,5	2,4	0,6	0,8	2,8	30,6	30,3	12,5	17,5
year									
quadrant year	10,0		2,1		18,5		51,3		17,6
spring	4,0	4,4	1,4	1,4	4,8	29,6	24,4	15,2	14,8
summer	1,6	1,6	0,7	0,4	3,0	29,4	32,4	12,8	18,1
autumn	3,0	3,0	0,5	0,7	2,0	30,0	31,1	15,3	14,4
winter	1,8	1,3	0,2	0,8	2,4	33,2	30,2	7,6	22,5

Gubałówka—Pajakówka 1927—36

I	7,8	1,5	3,9	0,3	1,4	3,6	29,9	5,7	45,9
II	4,7	3,5	7,8	0,3	1,4	6,0	34,8	3,6	37,9
III	6,6	2,7	9,3	0,3	2,5	4,1	30,4	8,1	36,0
IV	6,5	2,2	11,0	0,0	3,6	12,0	30,0	4,7	30,0
V	5,3	3,9	13,6	0,3	7,0	6,4	24,8	6,1	32,6
VI	7,1	2,0	9,1	3,0	5,2	4,5	31,0	5,3	32,8
VII	5,9	1,3	3,7	0,5	5,1	4,7	41,2	5,3	31,8
VIII	6,9	2,1	6,8	0,3	2,4	3,4	37,7	5,4	35,0
IX	7,6	1,4	7,2	0,2	2,3	5,1	42,6	6,1	27,5
X	6,8	4,5	5,6	0,3	4,1	5,6	44,0	4,7	27,4
XI	5,4	0,8	2,1	0,2	2,9	9,1	33,6	4,4	41,5
XII	4,2	1,5	8,4	0,1	1,8	4,7	27,6	4,5	47,2
year	6,2	2,3	7,4	0,4	3,3	5,6	34,0	5,3	35,5
year									
quadrant year	10,0		8,8		6,3		39,4		35,5
spring	6,2	2,7	11,3	0,2	4,4	7,7	28,4	6,3	32,8
summer	6,6	1,8	6,5	1,3	4,2	4,3	36,6	5,5	33,2
autumn	6,6	1,2	5,0	0,2	3,1	6,6	40,1	5,1	32,1
winter	5,6	2,2	6,9	0,2	1,5	4,8	30,8	4,5	43,5

Direction	N	NE	E	SE	S	SW	W	NW	C
				Hala Gasienicowa 1927—38, 1947—53					
.	6,0	7,9	2,5	2,8	13,4	44,4	5,4	3,4	14,2
II	10,1	12,1	2,6	2,8	11,8	34,2	7,2	5,4	13,8
III	8,9	9,8	1,5	2,4	13,6	36,1	8,0	5,9	12,0
IV	9,8	9,5	2,5	2,4	16,6	34,1	6,7	5,2	13,2
V	9,0	13,1	4,0	3,3	15,2	29,9	5,5	4,6	15,4
VI	15,9	13,2	5,1	4,2	13,2	19,7	6,1	7,1	15,5
VII	14,3	13,9	4,9	4,0	13,5	19,9	7,2	8,7	13,5
VIII	16,0	13,2	4,5	3,0	12,0	[illegible]	5,6	6,4	16,6
IX	13,1	9,6	2,8	2,8	14,4	31,5	4,7	6,6	14.5
X	8,0	8,7	2,4	3,4	16,4	37,9	6,1	4,6	12,5
XI	5,1	6,5	2.9	3,4	18,9	39,0	4,4	3,8	16,0
XII	5.9	6,5	2,3	3,0	14,2	43.9	4.8	2,6	16,8
year	10,1	11.4	3,2	3,5	12.5	33.5	6.1	5.2	14.5
year									
quadrant year	18.4		10,6		31,0		25.5		14.5
spring	9.3	10,8	2.8	2,8	15,2	33.5	6.8	5.3	13.5
summer	15,3	13,4	4.8	3,7	13,2	20,8	6,3	7.4	15,2
autumn	8.6	8.2	2,6	2,8	16,3	36.0	5.0	5.0	15,0
winter	7.3	8.8	2.5	2.9	13,1	40.8	5.8	3.9	14.9
				Hala Ornak 1950—53					
I	8,2	9,4	9,2	9,7	14,2	5,4	2,2	1,3	40.4
II	6,2	8,6	11.1	11,0	19,1	8,6	2,0	3,1	30,3
III	14,8	2,0	7,9	5,4	15,1	3.5	0.2	5,8	45.3
IV	0,0	12,3	17,6	14,9	33,6	3.2	0,0	0,0	18,4
V	5,5	4,8	18,7	1,8	12.7	1,8	1.4	2,9	50.4
VI	2,9	9.8	19,6	3,7	7,9	1,3	2,5	2,6	44.2
VII	6.5	7,9	6,6	7.9	9.6	2,5	1.9	4,8	52,3
VIII	7,5	3,4	3,4	1,5	8,1	4,9	2,7	3,7	64,3
IX	5.0	7,3	14,9	3,0	17,3	4,5	1,9	1,9	43,7
X	5,8	7,0	9,1	2,8	6,7	6,0	2,5	1.6	58.5
XI	5,0	6,7	14,2	2,8	23.1	10.3	2,5	2,1	33,3
XII	2,7	1,6	16,7	10,2	18,3	4,3	2,1	2,7	41,4
year	7,3	6,8	11,3	6,2	13.9	[illegible]	1,9	2.4	45,5
year									
quadrant year	11,9		17,8		19,3		5.5		45,5
spring	6,8	6,4	14,7	7,3	20,5	2,8	0.5	2,9	38,1
summer	5,6	7,0	9,9	6,0	8,5	3,2	2,3	3,7	53.8
autumn	5,3	7,2	12,7	2,9	15,7	6,9	2,3	1,9	45,1
winter	5,7	6,5	12,3	10,3	17,2	6,1	2,1	2,4	37,4

Kasprowy Wierch 1938—51 (wg M. Orlicza)

Direction	N	NE	E	SE	S	SW	W	NW	C
I	15,9	9,8	2,8	7,2	20,8	13,5	11,9	12,8	5.3
II	17,1	9,2	3,1	6,7	21,2	12,5	13,5	12,1	4,6
III	21,3	10,4	3,7	6,1	17,7	12,1	12,1	11,1	5,5
IV	20,1	9,3	2,9	8,2	21,6	13,7	10,1	9,2	4,9
V	19,9	13,6	4,7	8,5	18,2	12,8	8,8	7,3	6,2
VI	27,1	13,0	2,6	5,4	13,7	11,2	10,0	10,8	6,2
VII	27,3	9,9	2,1	5,5	12,7	11,9	12,2	11,7	6,7
VIII	18,3	10,4	3,3	7,8	18,1	16,0	10,2	9,9	6.0
IX	15,6	9,1	2,3	6,7	20,9	16,0	13,1	9,9	6,4
X	14,3	10,5	3,9	10,5	22,4	13,8	11,4	7,3	5.9
XI	11,2	8,7	3,2	10,1	26,6	13,9	12.2	9.8	4.3
XII	14,5	12,5	4,0	10,0	22,3	11.5	11.0	8,7	5,5
year	18,6	10,5	3,2	7,7	19,7	13.2	11.4	10,1	5,6
year									
quadrant year	28,9		12.3		30.1		23.[illegible]		5,6
spring	20,4	11,1	3,8	7.6	19,2	12.9	10,3	9,2	5.5
summer	24.3	11,1	2.7	6.2	14,8	13,0	10,8	10,8	6,3
autumn	13,7	9,4	3.1	9,1	23,3	14,6	12,3	9 0	5.5
winter	15,8	10,5	3.3	8,0	21.5	12,5	12,1	11.2	5.1

Kuznice 1950—53

Direction	N	NE	E	SE	S	SW	W	NW	C
I	1,7	6,0	0,0	1,9	17.6	12,4	2.8	1.9	51,7
II	5.9	2.6	2.0	3,9	22.1	11,8	0,7	2,8	48,2
III	10.5	5,9	0,0	1,6	23,7	14,4	1,9	3,8	[illegible]
IV	5,6	2.9	0,3	1,8	30.2	21,8	2,3	4,9	30.2
V	9.8	6,6	1.3	1,4	20,2	14,4	2,0	5.0	29.3
VI	12.5	9.1	1,4	1,7	19.8	14.8	2,3	4.2	[illegible]
VII	9.2	7,7	3,9	2,7	23,2	19,3	0,9	2,7	30,4
VIII	7,6	5,6	1,1	1,2	25,3	23,4	0,6	4,1	31,1
IX	5,7	5,6	1,1	3.1	26.8	22.6	0,9	2.3	31,9
X	4.9	4,2	1.1	2.4	25.9	21.9	1,4	6,7	31,5
XI	4.9	4,1	0,8	3.5	30.0	22,0	1,7	1,7	31.3
XII	3,6	2.9	0,0	1,7	29.1	20.9	0,4	1,7	39,7
year	7,1	5,3	1,1	2.1	24,8	18,2	1,5	3,3	36,5
year									
quadrant year	11,4		4,8		35.0		12,2		36,6
spring	8.6	5.2	0.5	1,6	24,7	16,9	2,1	4.6	35,8
summer	9,8	7,5	2.1	1,9	22.8	19,2	1,4	3.6	31,7
autumn	5,2	4.6	1,0	3,0	27,6	22,2	1,3	3.6	31,5
winter	5.1	3.8	0.7	2,5	22,9	15,0	1,4	2.1	46,6

[wg=according to]

Łysa Polana 1951—53

I	2,4	6,3	6,8	10,0	3,2	13,5	17,8	3,4	31,6
II	3,8	7,0	8,2	8,7	7,1	18,5	18,6	4,3	23,8
III	5,5	7,4	7,5	13,1	7,4	17,4	15,5	5,9	20,3
IV	1,7	5,2	13,3	19,4	12,0	15,0	7,6	0,7	25,1
V	2,1	8,3	13,2	17,2	11,9	16,3	12,4	0,7	17,1
VI	0,9	5,8	10,7	25,6	15,7	14,3	3,2	0,2	23,6
VII	0,3	5,6	13,3	21,9	16,9	13,9	7,4	1,3	19,4
VIII	1,1	5,4	6,8	18,5	15,6	15,1	15,0	0,2	22,5
IX	2,0	4,1	10,7	20,2	9,7	13,1	10,9	4,5	24,8
X	3,2	5,9	11,1	19,2	6,5	10,7	11,5	2,5	23,4
XI	0,3	2,8	13,3	20,6	4,7	17,8	16,7	0,5	23,3
XII	3,2	5,4	11,0	20,3	3,5	8,8	11,6	1,2	35,0
year	2,3	5,8	10,4	17,7	9,9	15,0	12,3	2,2	24,4
year									
quadrant year	6,3		22,1		26,3		20,9		24,4
spring	3,1	7,0	11,3	16,6	10,4	16,2	11,8	2,4	21,2
summer	0,8	5,6	10,3	22,0	16,1	14,4	8,5	0,6	21,7
autumn	1,8	4,3	11,7	20,0	7,0	13,8	13,0	2,5	25,9
winter	3,1	6,2	8,7	13,0	4,6	15,3	16,0	3,0	30,1

Morskie Oko 1927—38, 1948—53

I	5,3	5,8	2,2	5,3	6,5	14,5	7,9	4,2	49,3
II	8,1	9,6	2,2	5,4	4,1	11,9	8,2	3,1	47,4
III	8,7	7,9	2,1	3,5	6,5	16,4	7,1	1,7	46,1
IV	6,4	7,5	2,2	2,7	6,5	16,3	9,0	2,4	47,0
V	5,9	5,7	2,4	3,8	5,1	16,1	9,3	1,7	49,2
VI	7,1	9,3	3,2	5,6	6,5	11,4	9,1	1,8	46,0
VII	6,7	10,2	3,7	3,3	7,9	12,8	6,8	3,6	45,0
VIII	5,5	12,0	2,3	4,2	7,0	11,4	6,3	3,2	48,1
IX	6,4	9,5	2,5	4,5	7,8	13,4	7,9	3,8	44,2
X	8,5	6,6	1,6	5,8	7,6	17,2	7,6	2,1	43,0
XI	6,9	5,1	2,7	6,3	6,1	16,4	10,6	2,8	43,1
XII	5,2	6,0	1,8	4,1	5,4	14,0	9,5	2,8	51,2
year	6,9	7,3	2,5	4,7	6,8	14,4	9,7	2,8	45,9
year									
quadrant year	11,9		8,5		16,4		17,3		45,9
spring	7,1	7,1	2,1	3,4	6,0	16,4	8,5	1,9	47,5
summer	6,4	10,5	3,1	4,3	7,1	11,9	7,5	2,9	46,3
autumn	7,2	7,1	2,3	5,5	7,3	15,4	8,8	2,9	43,5
winter	6,2	7,1	2,1	4,9	5,3	13,5	8,5	3,5	48,9

Direction	N	NE	E	SE	S	SW	W	NW	C
			Myślenickie Turnie 1949—53						
I	4,3	7,8	14,4	6,3	17,2	38.8	4.2	4,6	2.4
II	9,3	10,4	5.7	3.5	13,9	43,1	8.7	5,0	0,4
III	9,0	10,4	11,5	3,4	10,2	32.3	8,2	7,2	7,8
IV	4,3	10,8	9,5	4,6	18,6	36,9	7,5	5,8	2,0
V	7,8	14,2	15,3	7,5	16,1	26,4	4,7	5,7	2,3
VI	8,1	19,6	18,5	8,1	13,7	17.0	9,1	5,4	0,5
VII	6,3	18,5	22,2	6,2	13,3	22,6	4,0	5,1	1,7
VIII	7,1	14,4	21,0	7,0	19.2	22,3	3,9	3,8	1,3
IX	5,4	9,2	15,3	5,9	22,8	32,0	4,2	4,2	1,0
X	4,5	9,6	17,7	9,4	17,6	31,0	3,9	3,7	2,6
XI	5,6	8,3	8,1	2,7	14,0	45,1	6,5	6,5	3,2
XII	3,6	7,5	8,8	6,0	15,7	45,0	7,3	4,3	1,8
year	6,3	11,9	14,2	6,0	16,0	32,3	6,0	5,2	2,1
year									
quadrant year	14,8		23.2		35,1		24,8		2,1
spring	7,0	11,8	12,1	5,2	15,0	31.9	6,8	6,2	4,0
summer	7,2	17,5	20.5	7.1	15,4	20.6	5,7	4,8	1,2
autumn	5,2	9.2	13,1	6,2	18,3	36,1	4,9	4,3	2,2
winter	5,7	8.5	9.6	5,3	15,6	42.3	6,7	4.7	1,6
			Poronin 1927—39, 1947—53						
I	9.0	6.5	11,5	1,4	1,3	5,2	25,6	6,4	33, 1
II	12.2	4.7	7.0	1,5	1.4	6.9	29.0	8,7	28,6
III	12,4	6.2	9.4	1,3	1,4	5.1	25,2	8,1	30,9
IV	10.2	5,6	10,3	2.4	1,9	7,2	26,6	7,7	23,1
V	8.3	7.2	12.3	3,8	3,4	5,3	19,8	5.7	34,2
VI	8.9	4.3	8.1	1,8	2,1	6,0	27.1	6.9	34.8
VII	9,6	4,1	4,9	1,1	2,0	6,7	31,5	8.1	32,0
VIII	10,9	4.8	7.4	0,9	1,7	5,8	27,6	8.3	32,6
IX	11,3	4,3	8.5	1,2	2.0	4,5	28,6	7.8	31.8
X	13,7	5.9	9,5	1,8	2.2	4.8	26.2	7.3	28,6
XI	11,3	6,0	8,5	1.6	2,2	4,2	25,6	7,3	33.3
XII	12.9	6,7	12.0	1,3	1,7	5,2	21,8	6,2	32.4
year	10.4	5.6	9.3	1.7	1.9	5,8	26.2	7,3	31.8
year									
quadrant year	16,9		12,9		5,7		32,7		31,8
spring	10,3	6,3	10,7	2.5	2,2	5,5	25,7	6.3	30.5
summer	9,8	4,4	6,8	1,3	1,9	6,2	28,6	7,7	33,3
autumn	12,1	5,4	8,6	1.5	2,3	4,5	26,8	7,4	31,4
winter	11,3	6,0	10,2	1,4	1,4	5,8	25,4	7.1	31,4

Witów 1951—53

I	2,7	0.5	1,1	1.6	4,2	29,3	32,5	5,1	22,8
II	1,0	1.2	0,0	3.5	4,2	19,0	32,0	6,0	31,1
III	1,4	0,9	2,3	2.8	2,5	18,4	32,2	12,5	27,9
IV	1,8	4,3	1,8	5,4	10,0	23,8	22,9	10,0	20,0
V	2,5	4,5	3,2	7,0	5,0	17,5	23,5	12,4	24,4
VI	0,6	2,4	1,9	12,2	5,0	18,9	23,0	7,2	28,8
VII	0,6	2,3	0.8	5,2	4,2	23,6	24,0	10,7	28,6
VIII	1,2	4,7	1,1	4,3	3,6	9,4	30,3	5,4	40,0
IX	1,3	1,1	1,8	1,7	2,5	13,6	37,0	5,0	36,0
X	1,3	2,6	1,8	4,7	4,1	12,6	22,3	11,9	38,7
XI	1,5	2,2	0,2	1,3	3,7	17,4	31.2	10,0	32,5
XII	0,8	1,7	0,3	0,3	3,6	21,7	28.4	7,0	36,2
year	1,6	2,2	0,9	2.2	3,1	20,0	29.0	10,0	31,0
year									
quadrant year	7,7		3,1		14,2		44,0		31,0
spring	1,9	3,2	2,4	5,1	5,8	19,9	26,1	11,5	24,1
summer	0,8	3,1	1,2	7,2	4,3	17,3	25,8	7,2	32,5
autumn	1,4	2,0	1,3	2,6	3,4	14,5	30,2	9,0	35,6
winter	1,5	1,1	0,5	2,4	4,0	23,3	31,0	6,1	30,1

Direction	N	NE	E	SE	S	SW	W	NW	C
	Zakopane 1921—39, 1943—44 (wg Gumińskiego)								
I	7.0	9,9	4.8	4,1	17,2	22,8	14,4	3,2	16,6
II	7,4	14,3	5,2	3,5	15,9	21,9	13,4	3,2	15,2
III	8,0	13,3	5,7	4,1	17,9	20.1	11.4	4,0	15.5
IV	7,4	10,8	5,5	5.3	15.2	22,4	12,5	5,2	15,7
V	8,9	11,8	7,5	5,7	14.5	17,4	8,9	6,6	18,7
VI	9,6	10,5	5.9	4,4	11,3	22.1	13.8	7,0	15.4
VII	7,5	8,4	3,6	4,9	13,1	24.0	14,7	8,3	15,5
VIII	6,1	9,2	3,5	5,1	16,4	22,1	13,4	6,5	17,7
IX	4,8	9,6	4,0	5,8	17,4	21,4	10.8	6.0	20.2
X	5,5	9.8	6.4	5,9	19,2	21,2	10.3	3,9	17,8
XI	4,9	10,8	6,0	4,4	17,7	22,0	13,0	1,9	19.3
XII	5,1	13.4	6,7	4,5	18.8	18,7	10.9	2,6	19,3
year	6.8	11,0	5,5	4,8	16,2	21,3	12,3	4,8	17,3
year									
quadrant year	14,7		13.4		29.3		25,3		17.3
spring	8,1	12,0	6,2	5,0	15,9	20,0	10.9	5,3	16,6
summer	7,7	9,3	4,4	4,8	13,6	22,7	14.0	7,3	16.2
autumn	5.2	10,1	5,6	5,0	18.2	21,6	11,3	3,9	19.1
winter	6.5	12,5	5.6	4,0	17.3	21.1	12.9	3,0	17,1

[wg=according to]

Zakopane 1952—53

I	1,8	9,9	5,5	3.2	6.3	22,0	13,2	4,3	33,8
II	0,5	8,1	5,3	6,0	1.6	24.5	16.5	4.0	33,5
III	3,4	4.0	3,2	1,5	5,[illegible]	27,8	12,4	4,8	42,0
IV	5.3	10,7	6,4	5,7	7,8	9.8	3,9	6,5	43.9
V	5,6	7,0	6,2	1,3	6.7	25,2	6,5	11,3	30,2
VI	5,0	6,7	5,6	4.2	6.1	18.9	10,5	6.4	36,6
VII	5.9	6,6	3,5	0,3	4.3	15.6	12,2	7,5	44,1
VIII	1,3	3,8	3,5	3.2	4.6	16,9	15,7	5,9	45,1
IX	3,3	2,8	4,8	8.3	9.4	19.6	6,7	3,5	41,6
X	1,9	11,0	2.4	2,3	9.4	21,0	6,2	5,1	40,7
XI	1,8	7,9	7,9	6,2	9,3	22,5	7,3	0,3	36,8
XII	1.5	9,1	9,8	5.3	10,2	12,1	5,6	0,2	46.2
year	3,1	7.3	5,3	3,9	6,8	19,8	9,7	4,8	39.3
year									
quadrant year	9,2		11,0		18,7		22,0		39,3
spring	4,8	7,3	5,4	2,8	6,9	18.9	7,6	7,5	38,8
summer	4,1	5,7	4,2	2,6	5,0	17,1	12,8	6.6	41,9
autumn	2,3	7,2	5,1	5,7	9,2	21,1	6,8	2,9	39,7
winter	1,3	9.0	6.9	4,8	6,0	19,5	11,8	2,7	38.0

Table 2. Wind velocities in %%. Hala Gasienicowa 1927-38, 1947-53, obs. 20712.

	wind velocity in %% in m/sec	N	NE	E	SE	S	SW	W	NW	C	total
January	0—2	3,1	2,9	1,2	1,0	2,1	12,2	3,4	1,7		27,6
	2—5	2,1	3,5	0,9	1,2	2,2	15,4	1,6	1,3		28,2
	5—10	0,7	1,3	0,3	0,4	4,1	9,7	0,3	0,4		17,2
	10—15	0,1	0,2	0,1	0,2	3,5	4,8	0,1	—		9,0
	15	—	—	—	—	1,5	2,3	—	—		3,8
	total	6,0	7,9	2,5	2,8	13,4	44,4	5,4	3,4	14,2	100,0
February	0— 2	5,0	4,5	1,3	1,1	1,4	10,1	4,9	3,3		31,6
	2— 5	3,2	5,5	0,7	1,1	2,4	12,3	1,9	1,4		28,5
	5—10	1,6	1,8	0,5	0,4	3,2	6,2	0,4	0,6		14,7
	10—15	0,3	0,3	0,1	0,2	3,2	3,4	—	0,1		7,6
	15	—	—	—	—	1,6	2,2	—	—		3,8
	total	10,1	12,1	2,6	2,8	11,8	34,2	7,2	5,4	13,8	100,0
March	0— 2	4,3	3,9	0,8	0,8	2,3	12,6	5,4	3,6		33,7
	2— 5	2,9	4,5	0,5	1,3	2,6	14,8	1,9	1,8		30,3
	5—10	1,6	1,3	0,2	0,3	3,3	6,9	0,5	0,5		14,6
	10—15	0,1	—	—	—	3,8	0,9	0,1	—		4,9
	15	—	0,1	—	—	1,6	0,8	0,1	—		2,5
	total	8,9	9,8	1,5	2,4	13,6	36,0	9,0	5,9	12,0	100,0
April	0— 2	5,9	4,7	1,3	1,2	3,5	11,6	5,3	3,4		36,9
	2— 5	3,4	4,2	0,9	0,7	4,8	12,9	1,0	1,4		29,3
	5—10	0,5	0,5	0,3	0,3	4,3	6,9	0,4	0,4		13,6
	10—15	—	—	—	—	3,8	2,7	—	—		6,5
	15	—	0,1	—	0,2	0,2	—	—	—		0,5
	total	9,0	13,1	4,0	3,3	15,2	29,9	5,5	4,6	15,4	100,0
May	0— 2	6,5	6,5	2,3	2,0	4,4	10,6	4,2	3,1		39,6
	2— 5	2,4	6,3	1,5	1,0	5,0	11,3	1,2	1,3		30,0
	5—10	0,1	0,3	0,2	0,2	3,5	6,4	0,1	0,2		11,0
	10—15	—	—	—	0,1	2,0	1,3	—	—		3,4
	15	—	—	—	—	0,3	0,3	—	—		0,6
	total	9,0	13,1	4,0	3,3	15,2	29,9	5,5	4,6	15,4	100,0
June	0— 2	12,0	8,4	3,3	1,8	4,5	6,6	4,0	5,2		45,8
	2— 5	3,7	4,6	1,8	1,2	4,8	9,0	1,7	1,8		28,6
	5—10	0,2	0,2	—	0,2	3,2	4,0	0,4	0,1		8,3
	10—15	—	—	—	—	0,7	0,5	0,1	—		1,3
	15	—	—	—	—	0,3	0,2	—	—		0,5
	total	15,9	13,2	5,1	4,2	13,2	19,7	6,1	7,1	15,5	100,0

Table 2(Continued).

Month	Wind velocity in %% in m/sec	N	NE	E	SE	S	SW	W	NW	C	total
July	0— 2	9.9	9.6	3.4	2.9	4.7	7.5	4.7	6.5		49.3
	2— 5	4.3	4.1	1,4	0.8	4,5	7.9	2.3	2.2		27.5
	5—10	0.1	0.2	0.1	0.3	3.3	3,5	0.2	—		7.7
	10—15	—	—	—	—	0,9	0.8	—	—		1,7
	>15	—	—	—	—	0,2	0.1	—	—		0.3
	total	14.3	13.9	4.9	4,0	13,6	19.9	7.2	8,7	13,5	100,0
August	0— 2	11,6	7.3	3.1	2,3	3.8	10,0	4.3	4.7		47.1
	2— 5	4.0	5,4	1.3	0,6	4.2	7.8	1.2	1,5		26.0
	5—10	0.4	0.5	0,1	0.1	3.0	4.0	0.1	0.2		8.4
	>10—15	—	—	—	—	0.9	0.6	—	—		1.5
	>15	—	—	—	—	0.1	0.3	—	—		0,4
	total	16.0	13.2	4.5	3 0	12,0	22.7	5.6	6.4	16.6	100.0
September	0— 2	8.9	5.4	1.9	1.6	3.7	13.0	3.4	4.5		42.4
	2— 5	4,0	3.9	0.8	1.2	5.3	11.5	1.3	1.9		29.9
	5—10	0.2	0.3	0.1	—	2.4	4.8	—	0.2		8.0
	10—15	—	—	—	—	2.4	1.8	—	—		4.2
	15	—	—	—	—	0.6	0.4	—	—		7.0
	total	13.1	9.6	2.8	2.8	14.4	31.5	4.7	6.6	14.5	100.0
October	0— 2	6.0	5,0	1,5	1.2	3.3	13.6	4.4	3.4		38.4
	2— 5	1,6	3.1	0.6	1.5	3.1	12.3	1.2	1.1		24.5
	5—10	0.4	0.5	0.3	0.6	4,3	8.7	0.5	0.1		15.4
	10—15	—	0.1	—	0.1	4.5	2.6	—	—		7.3
	15	—	—	—	—	1.2	0.7	—	—		1.9
	total	8,0	8,7	2,4	3,4	16,4	37.9	6,1	4.6	12.5	100.0
November	0— 2	3.4	3.9	1.8	2.1	2.7	10.6	2,8	2,7		30,0
	2— 5	1,4	1,9	0.9	0.9	3.1	13.5	1.2	0.7		23.6
	5—10	0.3	0.7	0.2	0.4	4.9	8,8	—	0.2		15.5
	10—15	—	—	—	—	6,3	5.0	0,4	0.2		11.9
	>15	—	—	—	—	1.9	1,1	—	—		5.0
	total	5,1	6,5	2.9	3,4	23.9	39.0	4,4	3.8	16.0	100.0
December	0— 2	3.9	3,9	1,2	0.9	2.3	14.8	2.8	1.4		31.2
	2— 5	1,4	2.0	0,8	1.6	2.6	14.6	1.6	0.9		25.5
	5—10	0,5	0,5	0,3	0.4	3.6	8,1	0.4	0.2		14.0
	10—15	0,1	0.1	—	0,1	4.4	4.8	—	0.1		9.6
	15	—	—	—	—	1,3	1,6	—	—		2.9
	total	5,9	6,5	2,3	3,0	14,2	43.9	4.8	2.6	18.8	100.0
Year	0— 2	6.4	5.6	2,1	1.6	3.6	11.5	4.3	7.2		38.3
	2— 5	3,1	4.8	0.9	1.4	3.8	11.9	1.5	1.3		29.2
	5 -10	0,5	0.9	0.2	0.4	6,7	0.2	0.2	—		13.3
	10—15	0,1	0.1	—	0.1	—	2,6	0,1	—		3.0
	>15	—	—	—	—	0,9	0.8	—	—		1.7
	total	10.1	11.4	3,2	3.5	12.5	33,5	6.1	5.2	14.5	100,0

Table 3. Wind velocities in %%.

m/sec	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	year
					Kasprowy Wierch 1941—1944 (wg M. Orlicza)								
0— 1	9,4	7,1	7.3	5.8	15.3	19,2	14.5	18,8	20.3	13,4	9,4	12.1	12.7
2— 5	23,9	28,0	26.6	31.4	36.6	44,4	48,9	36,3	26.9	29,0	27,0	17,5	31,4
6— 9	33.6	32,7	36,0	31.1	30,9	22,5	24.5	29.8	30.8	31.2	31.7	27.4	30.2
10—15	22,1	19.8	21.0	22.5	13.7	11,4	9,4	12.1	13.6	18.3	21,9	19.9	17,1
16—22	8,6	8,3	8,0	7.8	3,0	2,5	2,2	3.0	6,7	6,2	7,8	15,0	6.6
>22	2,4	4,1	1,1	1,4	0.5	—	0,5	—	1.7	1,9	2,2	8,1	2,0
					Łomnica 1941—44								
0— 1	15,3	17,1	15.6	17.0	20.2	27.2	26,1	33.3	29,7	21,5	15,0	14.0	21.0
2— 5	33.6	42,5	38.2	40.3	45.2	46,1	46,5	43.0	47.8	48.4	41.4	40.0	42.8
6— 9	30,4	26,3	27,7	24.4	22.8	17.5	19,4	19.6	16,1	23,1	29.7	29.6	23.9
10—15	16,4	10,9	13.2	14,4	8,9	8.6	5,6	3.0	5,0	4,8	11,1	11,8	9,5
16—22	3.5	2,9	4,0	3.3	2.4	0.6	1,6	1.1	0,6	1,9	1.7	4.6	2.3
>22	0,8	0.3	1,3	0,6	0.5	—	0.8	—	0,8	0,3	1.1	—	0.5

wg = according to

Table 4. Wind velocities in %%

m/sec	N	NE	E	SE	S	SW	W	NW	C	total
Zakopane 1921—39, 1943—44 (wg R. Gumińskiego)										
0—2	4,1	6,8	3,6	3.8	12,3	11.1	3,7	2,2		47,6
>2—5	2,6	4,0	1,8	0,8	1.8	7.3	6,1	2,3		26,7
>5—10	0,1	0,2	0,1	0,2	1,1	2,3	2,3	0,3		6,6
>10—15	0.0	0.0	—	0,0	0,4	0.4	0.2	0,0		1,0
>15	—	—	—	0,0	0,6	0,2	0.0	0,0		0.8
total	6.8	11.0	5.5	4,8	16.2	21.3	12.3	4.8	17,3	100.0

wg = according to

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